

AD-A129 688

PROJECT SCHEDULING USING CRITICAL PATH METHOD AND  
CHARTING TECHNIQUES FOR..(U) CORPS OF ENGINEERS ST PAUL  
MN ST PAUL DISTRICT D D GRANSBERG ET AL. 09 MAY 83

1/4

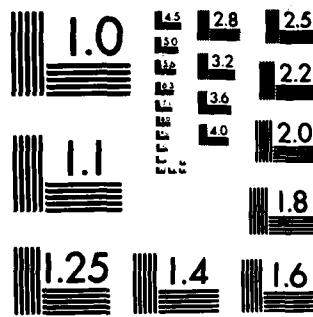
UNCLASSIFIED

F/G 9/2

NL

W-57  
100-100-100

END  
100-100-100  
7-83  
DTIC



MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS-1963-A

AUA 129688

~~UNCLASSIFIED~~

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
	AD-A129688	
4. TITLE (and Subtitle) PROJECT SCHEDULING USING CRITICAL PATH METHOD AND CHARTING TECHNIQUES FOR HARRIS COMPUTERS (*CPM); User's manual.		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Douglas D. Gransberg Robert C. Stackowiak		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineers, St. Paul District 1135 USPO & Custom House St. Paul, MN 55101		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE May 1983
		13. NUMBER OF PAGES 63
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report)
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report)  Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Computer applications Data management Management information systems		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The user's manual is designed for the *CPM system to provide non-ADP personnel with the information necessary to use the system effectively. A brief overview of critical path method (CPM) theory is provided, and illustrates the computations made by the program. The purpose of the program is to perform CPM calculations and provide an automated system for integrated multiple project scheduling and resource evaluation.		

DD FORM 1 JAN 73 1473

EDITION OF 1 NOV 68 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

## USER'S MANUAL

\*CPM

### Table of Contents

	<u>Page</u>
1. General	1
1.1 Purpose	1
1.2 Origin of the Program	1
1.3 References	1
1.4 Limitations of the Program	2
1.5 Definitions and Abbreviations	3
2. Summary	4
2.1 System Application	4
2.2 System Operation	4
2.3 Configuration	5
2.4 Organization	5
2.5 Performance	7
3. Staff Functions	7
3.1 Initiation	7
3.2 Staff Input Requirements	7
3.2.1 Input Formats	7
3.3 Output Requirements	7
4. CPM Theory	7
4.1 General	7
4.2 Network Development	8



A

Table of Contents (cont.)

	<u>Page</u>
4.3    CPM Computations	8
4.4    Resource Leveling Computations	10
5.    Input Development	13
5.1    General	13
5.2    Single Project Example	13
5.3    Multiple Project Example	13
6.    Output Displays	22
6.1    General	22
6.2    Single Project Example	23
6.3    Multiple Project Example	33
7.    RA/PM Interface	33

Figures

<u>Number</u>		<u>Page</u>
4.2-1	Activity on the arrow network for Project AAA	9
5.2-1	Input file created by option 1	14
5.2-2	Print program input file created by option 3	15
5.2-3	Calendar file created by option 4	17
5.3-1	Network for Project BBB	18
5.3-2	Network for Project CCC	19
5.3-3	Combined networks for multiple project analysis	20
5.3-4	Input file created by option 1 for multiple project analysis	21
6.2-1	CPM printed output file generated by option 5	24

Figures (cont.)

<u>Number</u>		<u>Page</u>
6.2-2	Plot file developed in option 5 for single project example	27
6.2-3	Single project Gantt Chart	28
6.2-4	Daily cost file created in option 6 for single project example (partial listing)	30
6.2-5	Single project resource histogram	31
6.2-6	Accumulated daily cost curve for single project example	32
6.3-1	Option 5 CPM printed output file for multiple project example	34
6.3-2	Option 5 plot file for multiple project example	35
6.3-3	Option 6 Gantt Chart for multiple project example	36
6.3-4	Option 6 resource histogram for multiple project example	41
6.3-5	Accumulated daily cost curve for multiple project example	42

Appendix A - User's Guide - CRT Displays and Answers

# ELECTRONIC COMPUTER PROGRAM ABSTRACT

TITLE OF PROGRAM <b>*CPM</b>		PROGRAM NO.	
PREPARING AGENCY <b>St. Paul District (See remarks)</b>			
AUTOMATOR CPT Douglas D. Gransberg Robert C. Stackowiak (See remarks)		DATE PROGRAM COMPLETED 9 May 1983	STATUS OF PROGRAM PHASE            STAGE
A. PURPOSE OF PROGRAM  To perform Critical Path Method (CPM) calculations and provide an automated system for integrated multiple project scheduling and resource evaluation.			
B. PROGRAM SPECIFICATIONS  This is an interactive program.			
C. METHODS  The program computes all CPM start and finish time, slack, activity costs, and resource requirements. When used in conjunction with an external heuristic program, resource leveling can be accomplished.			
D. EQUIPMENT DETAILS  Harris Version, Tektronix Graphics			
E. INPUT-OUTPUT  Input entered interactively. Output directly on CRT, or stored in file and listed later.			
F. ADDITIONAL REMARKS  This program is based on programs developed by Messrs. Noulet and Lambrecht of Pittsburgh and Mobile Districts, respectively. Modifications were added by Mr. Stackowiak from theory developed by CPT. Gransberg.			

## SECTION 1. GENERAL

### 1.1 Purpose

The objective of this user's manual for the \*CPM system is to provide non-ADP personnel with the information necessary to use the system effectively. Although section 3 of the manual contains a brief overview of critical path method (CPM) theory and illustrates the computations made by the program, it is assumed that the user has a reasonable knowledge of CPM.

### 1.2 Origin of the Program

The program was originally written in 1971 by Mr. Noullet of Pittsburgh District. In 1980, additions were made by Mr. Lambrecht of the Mobile District. In January 1983, CPT Douglas D. Gransberg of the St. Paul District was assigned the project of developing an automated system to simultaneously schedule multiple projects. At that time, he and Mr. Robert Stackowiak incorporated modifications and additions to the program.

### 1.3 References

- a. Network analysis systems in general and their particular applicability to the work of the Corps of Engineers are explained in ER 1-1-11, 1 March 1973.
- b. The technical report "Integrated Multiple Project Scheduling System" by CPT Gransberg explains the use of the program with multiple projects. The report has been filed with and is available through the Defense Technology Information Center.
- c. The following is a list of suggested references for those who wish to learn more about CPM:
  - (1) Department of the Army, 1982. Network Analysis Systems Course, Corps of Engineers Training Center, Huntsville, Alabama.
  - (2) Hoare, H.R., 1973. Project Management Using Network Analysis, McGraw-Hill, New York.
  - (3) Meredith, D.D., et al., 1973. Design and Planning of Engineering Systems, Prentice-Hall, Englewood Cliffs, N.J.
  - (4) Rekow, E.D., 1982. Project Management Guidelines, St. Paul District, St. Paul, MN.
  - (5) Riggs, J.L., 1976. Production System: Planning Analysis and Control, John Wiley and Sons.

(6) Shaffer, L.R., et al., 1965. The Critical Path Method, McGraw Hill, New York.

(7) Wiest, J.D. and F.K. Levy, 1977. A Management Guide to PERT/CPM, Prentice-Hall, Engelwood Cliffs, N.J.

#### 1.4 Limitations of the Program

Program capacity limitations are shown below. These limitations will probably not constrain the analysis of a single project. However, the user must be very careful to ensure that the limitations are not exceeded when using the program in a multi-project mode.

- a. The maximum number of activities is 3,000. This includes dummies.
- b. Every activity must have a unique I-J (event) number. Therefore, projects with a great number of parallel paths will have a large number of dummies, which may reduce the total usable capacity for real activities. The J number of an activity must always be greater than its I number.
- c. The program can only calculate closed networks. Therefore, individual project networks must be linked together at the beginning and end by dummies for multiple project analysis. This creates false start and stop events and makes output interpretation on a project-by-project basis somewhat tricky. However, some familiarity with the output makes accurate analysis possible. Use of the project sort can expedite this process.
- d. Assembly of a large initial calendar file is required to ensure that the available "time window" is great enough for the network to occupy. The calendar file can be reduced after the initial run.
- e. Strict coding of activity descriptions is required to allow project and organizational sorting. The project code and organization code must each have three digits, and they must appear as the first item of the activity description (i.e., ABC-FE1, Interior Drainage).
- f. Activity durations must be in calendar days.
- g. The amount of output requires a 132-character display. However, a cathode ray tube (CRT) can usually only display 80 characters per line. This causes the output to be "wrapped" on the screen, making data interpretation on the CRT tedious.
- h. The search option can search for a maximum of 10 codes through a maximum of 1,250 activities.

## 1.5 Definitions and Abbreviations

**Algorithm:** A set of rules for solving a problem in a finite number of steps.

**AS:** Actual start date - the date an activity is actually started.

**Bar Chart:** A scaled, graphical representation of a schedule.

**CPM:** Critical path method.

**CRT:** Cathode ray tube.

**Dummy Arrow:** An activity shown by a dotted line used to establish a technological precedence relationship which has no duration or cost.

**EF:** Early finish - the earliest time an activity can be completed.

**ES:** Early start - the earliest time an activity can be started.

**Gantt Chart:** A bar chart which shows slack.

**Heuristics:** A set of rules which serve to indicate the arrival at a desired solution.

**Histogram:** A graph of frequency distribution.

**I Number:** The event number at the tail of an activity arrow.

**J Number:** The event number at the head of an activity arrow.

**LF:** Late start - the latest time an activity can be finished.

**LS:** Late start - the latest time an activity can be started.

**MS:** Milestone - the date on which an activity must be completed.

**Precedence Networking:** A system of networking, similar to CPM, which allows activities to overlap.

**RA/PM:** Resource Allocation/Project Management.

**RS:** Remaining slack - the amount of slack remaining in an activity after it has actually been started.

**Sort:** An organization of data in a specific format.

**TS:** Total slack, the difference between the LF and EF of an activity.

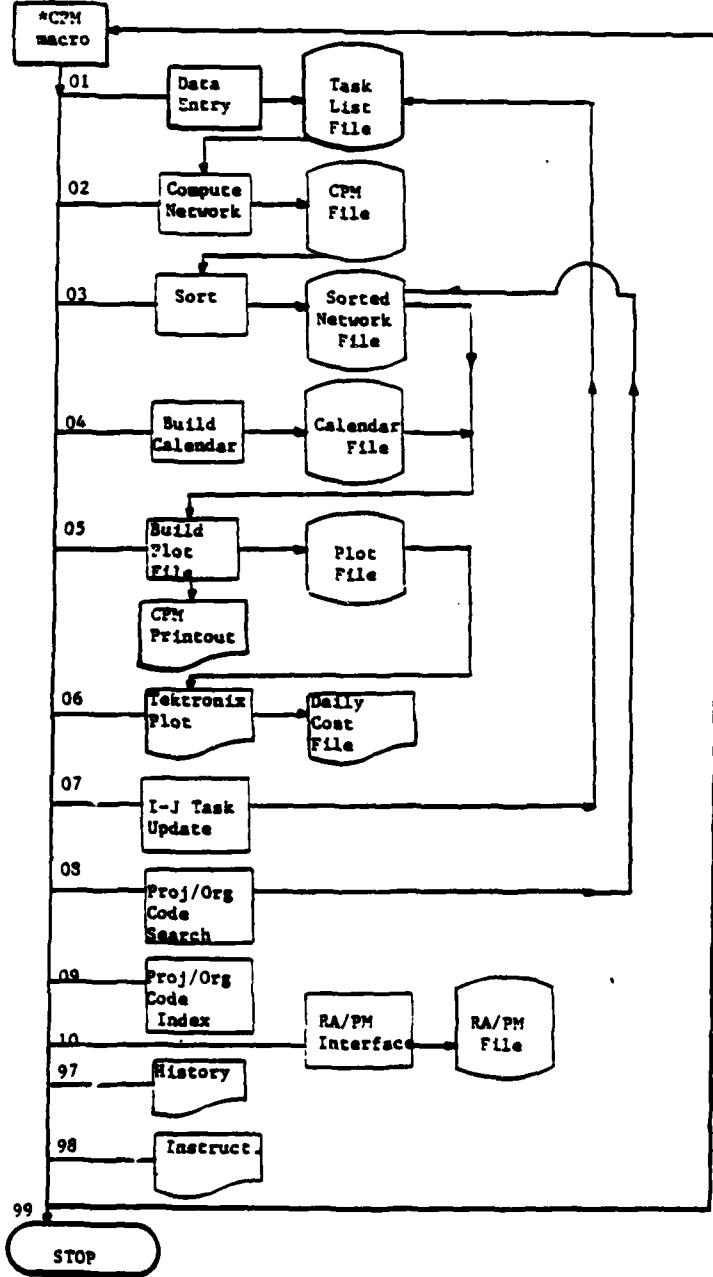
## SECTION 2. SUMMARY

### 2.1 System Application

The CPM system enables the user to run network analyses and trace the critical path with a Harris minicomputer. The programs in the system are interactive and prompt the user for data entries, file names, etc.

### 2.2 System Operation

The following chart illustrates the system's basic operations and relationships.



### 2.3 Configuration

All programs in the system are run on a Harris minicomputer. Plots are done on a Tektronix plotter.

### 2.4 Organization

The system comprises the three following major elements:

- a. The CPM Macro. This macro controls the execution of the programs in the system. It displays a menu of options from which the terminal operator may select any of ten programs or view a brief history of this CPM or instructions on its use.
- b. Options.
  - 01 Data Entry Program: prompts the user to enter I-J numbers, descriptions, cost, duration, etc., and builds the task list file which becomes input to the next program.
  - 02 Compute CPM Network: computes the network and critical path. If the program should abort (e.g., because it discovered a loop in the network), it prints error messages. It builds the CPM file.
  - 03 Sort CPM File: sorts the CPM file into I-J order, late start order, early start order, etc. It produces the sorted CPM file.
  - 04 Calendar Program: prompts the user to enter the project starting date ("NTP ACK DATE") and builds a project calendar which begins with this date. All subsequent dates(e.g., late start, early finish), are based on this date, and the actual dates (as opposed to the formula "starting date + duration =...") are extracted from the calendar file.
  - 05 Print Program and Plot File Builder: prints the sorted CPM file and creates the plot file.
  - 06 Activity/Cost Tektronix Plot Program: plots activity versus date and average daily cost versus date. The user may also generate a file containing average daily costs. Note: this option must be run on a device with Tektronix graphics capability.
  - 07 Update Task List: offers the user the opportunity to update the task list file. It prompts for the file name, for an indication of whether the updating action is to be an addition, change, or deletion, and for the new data when appropriate. This option may be used to add actual start date,

percent complete, or milestone date. The updated task list file may then be entered as input to option 02, thus creating a new network.

- 08 Search for Organization/Project Codes: writes selected tasks from the sorted CPM network file (option 03) into a new file which may then be used as input to the print program (option 05).
- 09 Organization/Project Codes: Index: allows the user to create a new file of codes and their descriptions, search an existing index file for organization and/or project codes, or add codes and their descriptions to an existing index file.
- 10 CPM-RA/PM Interface Program: allows the user to convert a CPM sorted network file (option 03) into RA/PM input.
- 97 CPM History: provides the user with the names of CPM source program files, where and when they were developed, and the language they are written in.
- 98 CPM Instructions: provides the user with brief instructions on how to use the options.
- 99 Terminate CPM: returns the user to job control.

c. Files.

The system uses the following files:

- (1) Task list file - I-J nodes, duration, cost, etc.
- (2) CPM file - the network, unsorted and without dates.
- (3) Sorted CPM file - sorted in the following orders:

I-J SORT  
LATE START SORT  
EARLY START SORT  
EARLY FINISH SORT  
LATE FINISH SORT  
TOTAL SLACK SORT

- (4) Calendar file - starting date to ending + 15%.
- (5) Plot file - the CPM data and calendar files formatted for input to the activity/cost Tektronix plot program.
- (6) RA/PM file - sorted network file formatted for input to RA/PM.

## 2.5 Performance

The CPM system interactively performs fast and accurate network analyses, plots the activities and costs, and updates its files.

## 2.6 General description

- a. Input. Input to the programs comes from the operator's responses to prompts and from files built by other programs.
- b. Processing. The CPM data are processed by both FORTRAN and COBOL programs.
- c. Output. Sorted network lists, daily costs, Tektronix plots of activities and daily costs, and RA/PM input.

## SECTION 3. STAFF FUNCTIONS

### 3.1 Initiation

After normal sign-on procedures, the user enters \*CPM and depresses the ENTER or RETURN (depending on the type of terminal) key. The CPM macro then takes control and displays a menu of options and the numeric codes which must be entered to execute them.

### 3.2 Staff Input Requirements

All input requirements are controlled by the system. The CPM macro displays a menu of programs, and the programs guide the user's entries by prompting and by error messages when appropriate.

#### 3.2.1 Input Formats

The system displays all formats required for data entry.

### 3.3 Output Requirements

Output files may be printed in ADP by entering CO, file name, :6,NC. Plotting is done on the Tektronix.

## SECTION 4. CPM THEORY

### 4.1 General

This section provides a brief review of CPM theory, highlighting the important areas for use in the \*CPM program. It is assumed that the user is generally familiar with CPM and its uses. If this is not the case, the user should refer to the literature cited in paragraph 1.3.

## 4.2 Network Development

The program is designed to be used with an "Activity on the Arrow" network such as that shown in figure 4.2-1. To assemble such a network, the user must first list all activities required for project completion. These activities must be shown on the network on the basis of their technological precedence. CPM requires that one activity end before another can begin. Therefore, the possibility of overlapping technologically related activities is eliminated.

Dummy arrows are used to show technological precedence relationships where an activity's completion relates to the start of two or more activities on parallel paths. Because each activity must have a unique I-J number, dummies are also used when two or more activities start and end on the same nodes. Additionally, dummies are required to connect the initial and final nodes of each project to a common start and finish node to use the program for multi-project analysis.

## 4.3 CPM Computations

Once the network has been drawn, computations can be made to determine the critical path through the network. The critical path algorithm is based on a series of computations made using the durations of the activities. It follows each possible path through the network. The algorithm follows (definitions and abbreviations are found in paragraph 1.5).

- a. Make a forward pass through the network from beginning to end computing the ES and EF times of each activity. The EF of an activity (x) equals its ES time plus its duration (d) or

$$EF(x) = ES(x) + d(x) \dots \dots \dots \dots \dots \dots \dots \quad \text{Equation 1.}$$

The ES of all activities emanating from a node equals the greatest EF of all activities terminating at that node. For example, if an activity is the initial activity in the network and has a duration of 12 calendar days, its ES would equal 0, its EF would equal 12, and the ES of all activities which emanate from its ending node would be 12.

- b. Make a backward pass through the network from end to beginning, using the greatest EF time for any activity terminating at the final node as the LF time at that node. Compute the LF and LS times for each activity using the following equation:

$$LS(x) = LF(x) - d(x) \dots \dots \dots \dots \dots \dots \dots \quad \text{Equation 2.}$$

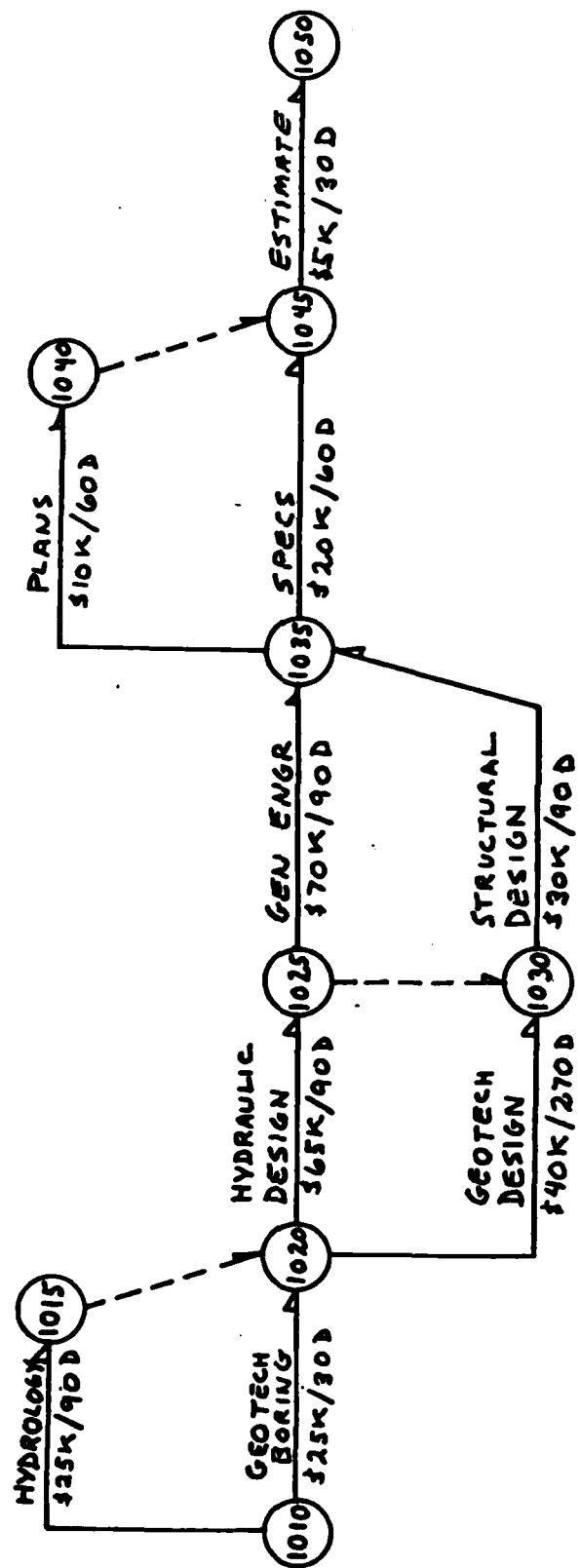


Figure 4.2-1: Activity on the arrow network for Project AAA.

c. Compute the total slack (TS) for each activity using Equation 3 or 4.

d. Those activities whose TS = 0 are on the critical path.

\*CPM has the ability to constrain the theoretical network to reality through the use of actual start dates (AS) and milestone (MS) dates. This requires a slight divergence from classical CPM theory. Generally, when a network is constrained by start and finish dates, the slack computations must be revised to give an accurate picture of which activities are truly critical. The concept of remaining slack (RS) must therefore be introduced.

If an activity has an AS, the program will replace its ES with the AS.  
(Note: Students of CPM should not confuse this concept with the theoretical concepts of free slack or interfering slack. The program does not make these computations.)

Additionally, the input of an MS also affects the activity's slack. If an activity has an MS, the program will replace the LF of the activity with the MS and recompute the TS.

It is entirely possible to get a negative number for either RS or TS. If RS is negative, the activity was started after its late start date. If TS is negative, the activity cannot be finished before its milestone date. It is obvious that the appearance of negative slack in a network can give a project manager some very valuable information about the status of his project.

#### 4.4 Resource Leveling Computations

To allow resource leveling decisions to be made, the program converts the CPM network into a Gantt Chart and vertically sums the resource requirement of each activity that occurs on a given day. Those total daily costs are then plotted as a histogram. The goal of this exercise is to distribute the total workload as evenly as possible across the selected period of time. This is done by comparing the ES and LF resource histograms with the ES bar chart. Before this operation can be explained in detail, the comparison criteria must be understood. The resource requirement is measured in dollars per day and is determined for an individual activity by dividing

the activity's total cost (the organization's project budget) by its duration. This operation assumes that the money allocated for a single activity is uniformly expended throughout its duration. Consequently, the total resource requirement for any one day will be the sum of the individual activity resource requirements that are scheduled for that day. That sum can then be compared to the maximum amount of dollars that the parent organization can expend on any given day to determine if the parent organization will be over or under committed on that particular day. For purposes of this report, parent organization is defined as the aggregate of functional elements over which it has control. This theory can be reduced to the following equations:

Where:  $r_x$  = Resource requirement for activity "x" (\$/day)

$c_x$  = Total cost for activity "x" (\$)

$d_x$  = Duration of activity "x" (Days)

And:  $R_i$  = Total resource requirement on day "i" (\$)

i = Day

$R_{max}$  = Maximum daily resource capacity for parent organization

**Therefore:**

Then: The parent organization is over committed

Then: The parent organization is fully committed

Then: The parent organization is under committed

Resource leveling can now begin, using this theory and the updating option of \*CPM. A simple heuristic program is used iteratively until a satisfactory solution is reached. The program is based on four rules (heuristics):

a. Allocate resources serially in time (i.e., start with ES schedule).

b. Give preference to activities with the least slack.

c. Reschedule non-critical activities to free resources for critical activities.

d. If using the program for multi-project analysis, schedule activities by project priority as determined by executive group.

The heuristic program is applied using the following sequence of events:

a. Locate times in which  $R_i > R_{max}$  on ES resource histogram.

b. Check corresponding times on ES Gantt Chart to determine which activities have slack and which activities do not (i.e., critical activities).

c. Add the resource requirement for those activities with no slack. If this amount is greater than  $R_{max}$ , the parent organization will be over committed unless a means to shorten the duration of critical activities can be found.

d. Attempt to schedule activities with slack at a point between their ES and LS date where  $R_i < R_{max}$ . Call these dates tentative actual start dates.

e. Using the LF Gantt Chart, the LF resource histogram and the TS sort, identify which milestones are most heavily limiting the overall system. Select tentative new milestones, if possible, for super-critical activities. A super-critical activity is defined as one which cannot meet its milestone.

f. Update the master file with newly determined tentative actual start dates, tentative new milestones, revised durations, and other changes.

g. Run newest update. Analyze that output and repeat the process until a satisfactory solution is reached.

It is doubtful that a level resource histogram can be derived. Therefore, the best possible solution will contain times when the parent organization is both over committed and under committed.

## SECTION 5. INPUT DEVELOPMENT

### 5.1 General

The input for the program comes directly off the network diagram. A form listing the pertinent information for each activity in the following order would be helpful:

- a. I number.
- b. J number.
- c. Cost (\$).
- d. Duration (calendar days).
- e. Three-digit project code; three-digit organization code.
- f. Activity description.
- g. Milestone date (month, day, year).
- h. Actual start date (month, day year).
- i. Percentage of completion.

Examples of how input is developed for both single and multiple project analysis are shown in the following paragraphs.

### 5.2 Single Project Example

The network shown in figure 4.2-1 will be analyzed in this example. Figure 5.2-1 is a copy of the input file created in option 1 of \*CPM. Figure 5.2-2 is the print program input file created in option 3. Figure 5.2-3 is the calendar file created by option 4. It should be noted that when creating the calendar file, the user should input the day before the first day of the time period to be analyzed. For example, if the user wanted to analyze FY 84, the proper response to the prompt "NTP ACK DATE (MMDDYY)?" would be "093083" (30 September 1983). This would make the first day of the calendar file 1 October 1983.

### 5.3 Multiple Project Example

Developing input for multiple project analysis is generally the same as for single project analysis. However, because the program and CPM theory are designed to analyze one network at a time, multiple projects must be tied together at the beginning and end with dummies. This example will add two networks to the one shown in figure 4.2-1. These are pictured in figures 5.3-1 and 5.3-2. Figure 5.3-3 shows how they are tied together. The input file created in option 1 is shown in figure 5.3-4. The same calendar file will be used.

**EXAMPLE FOR \*CPM  
USERS MANUAL OF A SINGLE  
PROJECT/NETWORK AND ITS INPUT AND OUTPUT FILES**

1010	1015	90	25000.AAA-EHO HYDROLOGY	0
1010	1020	30	25000.AAA-EGB GEOTECH BORINGS	0
1015	1020	0	0.DUMMY	0
1020	1025	90	65000.AAA-EHA HYDRAULIC DES	0
1020	1030270		40000.AAA-EGD GEOTECH DES	0
1025	1030	0	0.DUMMY	0
1025	1035	90	70000.AAA-EGE GENERAL ENGR	0
1030	1035	90	30000.AAA-EDS STRUCTURAL DES	0
1035	1040	60	10000.AAA-EDD PLANS	0
1035	1045	60	20000.AAA-ESP SPECIFICATIONS	0
1040	1045	0	0.DUMMY	0
1045	1050	30	5000.AAA-EDE ESTIMATE	0
-999	-999			0

EOT..

Figure 5.2-1: Input file created by option 1.

EXAMPLE FOR RCPM  
 USERS MANUAL OF A SINGLE  
 PROJECT/NETWORK AND ITS INPUT AND OUTPUT FILES

001010001015	90	0	25000.AAA-EHO HYDROLOGY	0	0
001010001020	30	0	25000.AAA-EGB GEOTECH BORINGS	0	0
001015001020	0	0	0.DUMMY	0	0
001020001025	90	0	45000.AAA-EHA HYDRAULIC DES	0	0
001020001030270	0	0	40000.AAA-EGD GEOTECH DES	0	0
001025001030	0	0	0.DUMMY	0	0
001025001035	90	0	70000.AAA-EGE GENERAL ENGR	0	0
001030001035	90	0	30000.AAA-EDS STRUCTURAL DES	0	0
001035001040	60	0	10000.AAA-EDO PLANS	0	0
001035001045	60	0	20000.AAA-ESP SPECIFICATIONS	0	0
001040001045	0	0	0.DUMMY	0	0
001045001050	30	0	5000.AAA-EDE ESTIMATE	0	0
<b>-999000000</b>					
LATE START SORT					
001010001015	90	0	25000.AAA-EHO HYDROLOGY	0	0
001010001020	30	0	25000.AAA-EGB GEOTECH BORINGS	0	0
001015001020	0	0	0.DUMMY	0	0
001020001030270	0	0	40000.AAA-EGD GEOTECH DES	0	0
001020001025	90	0	65000.AAA-EHA HYDRAULIC DES	0	0
001025001030	0	0	0.DUMMY	0	0
001025001035	90	0	70000.AAA-EGE GENERAL ENGR	0	0
001030001035	90	0	30000.AAA-EDS STRUCTURAL DES	0	0
001035001040	60	0	10000.AAA-EDO PLANS	0	0
001035001045	60	0	20000.AAA-ESP SPECIFICATIONS	0	0
001040001045	0	0	0.DUMMY	0	0
001045001050	30	0	5000.AAA-EDE ESTIMATE	0	0
<b>-999000000</b>					
EARLY START SORT					
001010001015	90	0	25000.AAA-EHO HYDROLOGY	0	0
001010001020	30	0	25000.AAA-EGB GEOTECH BORINGS	0	0
001015001020	0	0	0.DUMMY	0	0
001020001025	90	0	65000.AAA-EHA HYDRAULIC DES	0	0
001020001030270	0	0	40000.AAA-EGD GEOTECH DES	0	0
001025001030	0	0	0.DUMMY	0	0
001025001035	90	0	70000.AAA-EGE GENERAL ENGR	0	0
001030001035	90	0	30000.AAA-EDS STRUCTURAL DES	0	0
001035001040	60	0	10000.AAA-EDO PLANS	0	0
001035001045	60	0	20000.AAA-ESP SPECIFICATIONS	0	0
001040001045	0	0	0.DUMMY	0	0
001045001050	30	0	5000.AAA-EDE ESTIMATE	0	0
<b>-999000000</b>					
EARLY FINISH SORT					
001010001020	30	0	25000.AAA-EGB GEOTECH BORINGS	60	60
001010001015	90	0	25000.AAA-EHO HYDROLOGY	0	0
001015001020	0	0	0.DUMMY	0	0
001020001025	90	0	65000.AAA-EHA HYDRAULIC DES	0	0
001025001030	0	0	0.DUMMY	0	0
001025001035	90	0	70000.AAA-EGE GENERAL ENGR	0	0
001020001030270	0	0	40000.AAA-EGD GEOTECH DES	0	0
001030001035	90	0	30000.AAA-EDS STRUCTURAL DES	0	0
001035001040	60	0	10000.AAA-EDO PLANS	0	0
001035001045	60	0	20000.AAA-ESP SPECIFICATIONS	0	0
001040001045	0	0	0.DUMMY	0	0
001045001050	30	0	5000.AAA-EDE ESTIMATE	0	0
<b>-999000000</b>					
LATE FINISH SORT					
001010001015	90	0	25000.AAA-EHO HYDROLOGY	0	0
001010001020	30	0	25000.AAA-EGB GEOTECH BORINGS	0	0
001015001020	0	0	0.DUMMY	0	0
001020001025	90	0	65000.AAA-EHA HYDRAULIC DES	0	0
001020001030270	0	0	40000.AAA-EGD GEOTECH DES	0	0
001025001030	0	0	0.DUMMY	0	0
001025001035	90	0	70000.AAA-EGE GENERAL ENGR	0	0
001030001035	90	0	30000.AAA-EDS STRUCTURAL DES	0	0
001035001040	60	0	10000.AAA-EDO PLANS	0	0
001035001045	60	0	20000.AAA-ESP SPECIFICATIONS	0	0
001040001045	0	0	0.DUMMY	0	0
001045001050	30	0	5000.AAA-EDE ESTIMATE	0	0
<b>-999000000</b>					

Figure 5.2-2: Print program input file created by option 3.

TOTAL SLACK SORT		1		
001010001015	90 0	25000.AAA-EDD HYDROLOGY	00000000000000009000000090	0 0
001015001020	0 0	0.DUMMY	000000000090009000900090	0 0
001020001030270	0	40000.AAA-EGD GEOTECH DES	000000000090036000900360	0 0
001030001035	90 0	30000.AAA-EDS STRUCTURAL DES	0000000000360045003600450	0 0
001035001040	60 0	10000.AAA-EDD PLANS	0000000000450051004500510	0 0
001035001045	60 0	20000.AAA-ESP SPECIFICATIONS	0000000000450051004500510	0 0
001040001045	0 0	0.DUMMY	0000000000510051005100510	0 0
001045001050	30 0	5000.AAA-EDE ESTIMATE	0000000000510054005100540	0 0
001010001020	30 0	25000.AAA-EGB GEOTECH BORINGS	00000000000000003000600090	60 60
001020001025	90 0	65000.AAA-ENA HYDRAULIC DES	000000000090018002700360	180 180
001025001030	0 0	0.DUMMY	0000000000180018003600360	180 180
001025001035	90 0	70000.AAA-EGE GENERAL ENGR	0000000000180027003600450	180 180
-999000000				

EOF..  
EOF..  
EOT..

Figure 5.2-2: Print program input file created by option 3 (continued).

1	10	183	10	283	10	383	10	483	10	583	10	683	10	783	10	883	10	983	101083
11	101183	101283	101383	101483	101583	101683	101783	101883	101983	101983	102083								
21	102183	102283	102383	102483	102583	102683	102783	102883	102983	102983	103083								
31	103183	11183	11283	11383	11483	11583	11683	11783	11883	11883	11983								
41	111083	111183	111283	111383	111483	111583	111683	111783	111883	111883	111983								
51	112083	112183	112283	112383	112483	112583	112683	112783	112883	112883	112983								
61	113083	12183	12283	12383	12483	12583	12683	12783	12883	12883	12983								
71	121083	121183	121283	121383	121483	121583	121683	121783	121883	121883	121983								
81	122083	122183	122283	122383	122483	122583	122683	122783	122883	122883	122983								
91	123083	123183	1	184	1	284	1	384	1	484	1	584	1	684	1	784	1	884	
101	1	984	11084	11184	11284	11384	11484	11584	11684	11784	11884								
111	11984	12084	12184	12284	12384	12484	12584	12684	12784	12884									
121	12904	13004	13184	2	184	2	284	2	384	2	484	2	584	2	684	2	784		
131	2	884	2	984	21084	21184	21284	21384	21484	21584	21684								
141	21804	21984	22084	22184	22284	22384	22484	22584	22684	22784									
151	22884	22984	3	184	3	284	3	384	3	484	3	584	3	684	3	784	3	884	
161	3	984	31084	31184	31284	31384	31484	31584	31684	31784	31884								
171	31984	32084	32184	32284	32384	32484	32584	32684	32784	32884									
181	32984	33084	33184	4	184	4	284	4	384	4	484	4	584	4	684	4	784		
191	4	884	4	984	41084	41184	41284	41384	41484	41584	41684								
201	41884	41984	42084	42184	42284	42384	42484	42584	42684	42784									
211	42884	42984	43084	5	184	5	284	5	384	5	484	5	584	5	684	5	784		
221	5	884	5	984	51084	51184	51284	51384	51484	51584	51684								
231	51884	51984	52084	52184	52284	52384	52484	52584	52684	52784									
241	52884	52984	53084	53184	6	184	6	284	6	384	6	484	6	584	6	684			
251	6	784	6	884	6	984	61084	61184	61284	61384	61484	61584							
261	61784	61884	61984	62084	62184	62284	62384	62484	62584	62684									
271	62784	62884	62984	63084	7	184	7	284	7	384	7	484	7	584	7	684			
281	7	784	7	884	7	984	71084	71184	71284	71384	71484	71584							
291	71784	71884	71984	72084	72184	72284	72384	72484	72584	72684									
301	72784	72884	72984	73084	73184	8	184	8	284	8	384	8	484	8	584				
311	8	684	8	784	8	884	8	984	81084	81184	81284	81384	81484	81584					
321	81684	81784	81884	81984	82084	82184	82284	82384	82484	82584									
331	82684	82784	82884	82984	83084	83184	9	184	9	284	9	384	9	484					
341	9	504	9	684	9	784	9	884	9	984	91084	91184	91284	91384	91484				
351	91584	91684	91784	91884	91984	92084	92184	92284	92384	92484									
361	92584	92684	92784	92884	92984	93084	10	184	10	284	10	384	10	484					
371	10	584	10	684	10	784	10	884	10	984	101084	101184	101284	101384	101484				
381	101584	101684	101784	101884	101984	102084	102184	102284	102384	102484									
391	102584	102684	102784	102884	102984	103084	103184	11	184	11	284	11	384						
401	11	484	11	584	11	684	11	784	11	884	11	984	111084	111184	111284	111384			
411	111484	111584	111684	111784	111884	111984	112084	112184	112284	112384									
421	112484	112584	112684	112784	112884	112984	113084	12	184	12	284	12	384						
431	12	484	12	584	12	684	12	784	12	884	12	984	121084	121184	121284	121384			
441	121484	121584	121684	121784	121884	121984	122084	122184	122284	122384									
451	122484	122584	122684	122784	122884	122984	123084	123184	1	185	1	285							
461	1	385	1	485	1	585	1	685	1	785	1	885	1	985	11085	11185	11285		
471	11385	11485	11585	11685	11785	11885	11985	12085	12185	12285									
481	12385	12485	12585	12685	12785	12885	12985	13085	13185	13285									
491	2	285	2	385	2	485	2	585	2	685	2	785	2	885	2	985	21085	21185	
501	21285	21385	21485	21585	21685	21785	21885	21985	22085	22185									
511	22285	22385	22485	22585	22685	22785	22885	22985	23085	23185									
521	3	485	3	585	3	685	3	785	3	885	3	985	31085	31185	31285	31385			
531	31485	31585	31685	31785	31885	31985	32085	32185	32285	32385									
541	32485	32585	32685	32785	32885	32985	33085	33185	4	185	4	285							
551	4	385	4	485	4	585	4	685	4	785	4	885	4	985	41085	41185	41285		
561	41385	41485	41585	41685	41785	41885	41985	42085	42185	42285									
571	42385	42485	42585	42685	42785	42885	42985	43085	5	185	5	285							
581	5	385	5	485	5	585	5	685	5	785	5	885	5	985	51085	51185	51285		
591	51385	51485	51585	51685	51785	51885	51985	52085	52185	52285									
601	52305	52405	52505	52605	52705	52805	52905	53005	53105	0	0	0							

-994  
**CALENDAR FOR**  
**SINGLE PROJECT EXAMPLE**  
**\*CPM USERS MANUAL**  
**EOT**  
**EOT**

Figure 5.2-3: Calendar file created by option 4.

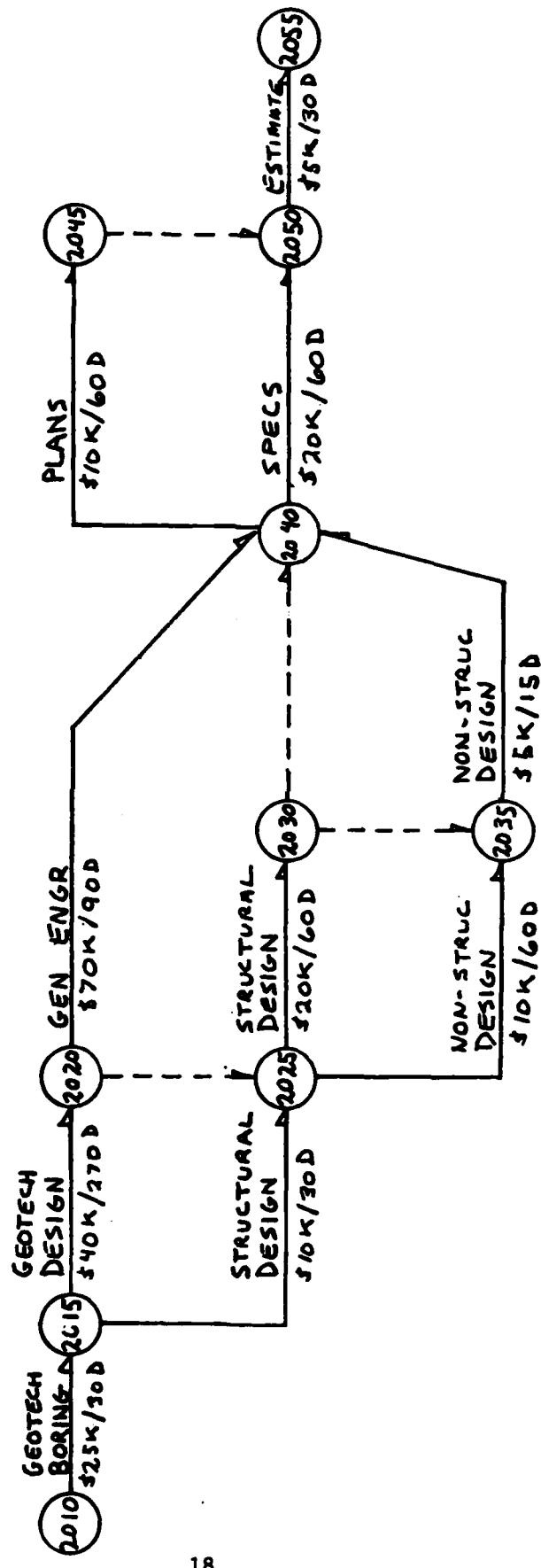


Figure 5.3-1: Network for Project BBB.

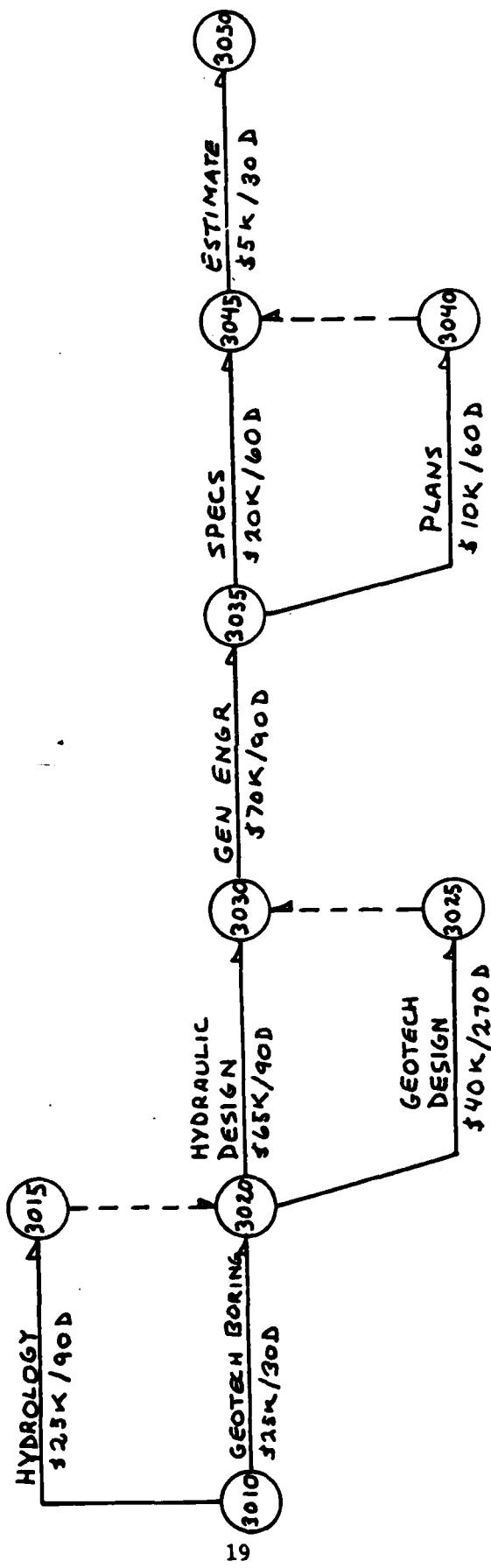


Figure 5.3-2: Network for Project CCC.

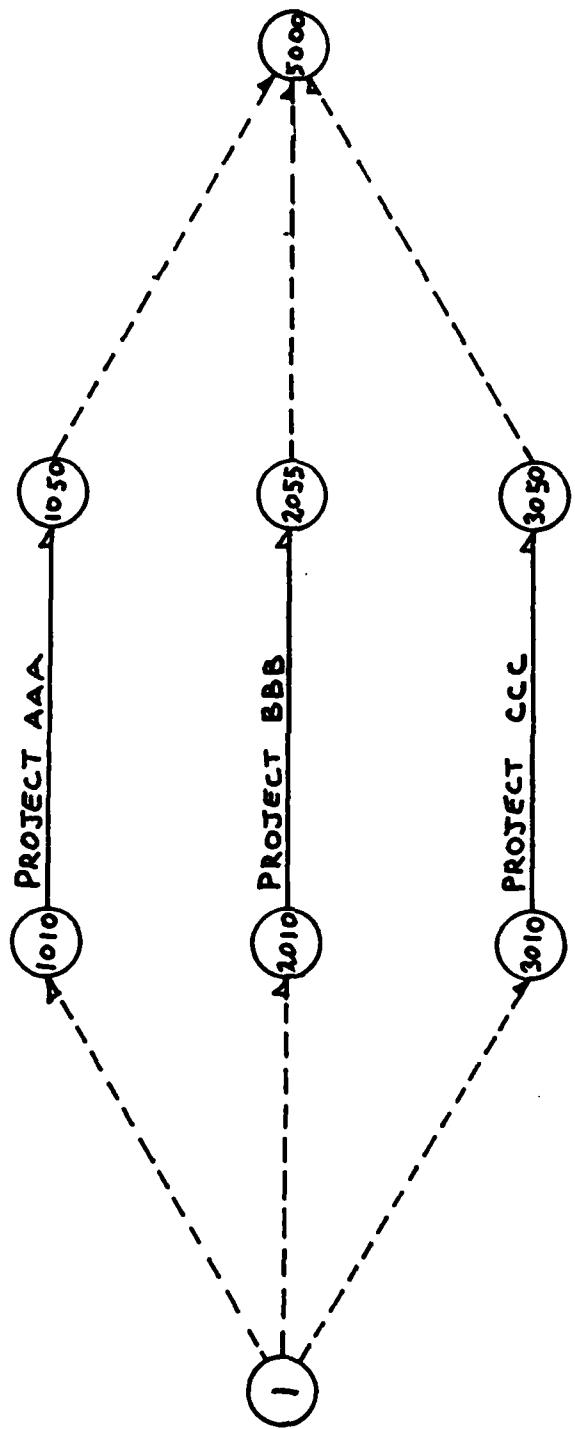


Figure 5.3-3: Combined networks for multiple project analysis.

I-J SORT  
EXAMPLE OF MULTIPLE  
PROJECT ANALYSIS FOR \*CPM  
USERS MANUAL

1	1010	0	0.DUMMY	0
1	2010	0	0.DUMMY	0
1	3010	0	0.DUMMY	0
1010	1015	90	25000.AAA-EHO HYDROLOGY	0
1010	1020	30	25000.AAA-EGB GEOTECH BORING	0
1015	1020	0	0.DUMMY	0
1020	1025	90	65000.AAA-EHA HYDRAULIC DESIGN	0
1020	1030270		40000.AAA-EGD GEOTECH DESIGN	0
1025	1030	0	0.DUMMY	0
1025	1035	90	70000.AAA-EGE GENERAL ENGR	0
1030	1035	90	30000.AAA-EDS STRUCTURAL DESIGN	0
1035	1040	60	10000.AAA-EDD PLANS	0
1035	1045	60	20000.AAA-ESP SPECIFICATIONS	0
1040	1045	0	0.DUMMY	0
1045	1050	30	5000.ESTIMATE	0
1050	5000	0	0.DUMMY	0
2010	2015	30	25000.BBB-EGB GEOTECH BORING	0
2015	2020270		40000.BBB-EGD GEOTECH DESIGN	0
2015	2025	30	10000.BBB-EDS STRUCTURAL DESIGN	0
2020	2025	0	0.DUMMY	0
2020	2040	90	70000.BBB-EGE GENERAL ENGR	0
2025	2030	60	20000.BBB-EDS STRUCTURAL DESIGN	0
2025	2035	60	10000.BBB-EDN NON-STRUCTURAL DESIGN	0
2030	2035	0	0.DUMMY	0
2030	2040	0	0.DUMMY	0
2035	2040	15	5000.BBB-EDN NON-STRUCUTURAL DESIGN	0
2040	2045	60	10000.BBB-EDD PLANS	0
2040	2050	60	20000.BBB-ESP SPECIFICATIONS	0
2045	2050	0	0.DUMMY	0
2050	2055	30	5000.BBB-EDE ESTIMATE	0
2055	5000	0	0.DUMMY	0
3010	3015	90	25000.CCC-EHO HYDROLOGY	0
3010	3020	30	25000.CCC-EGB GEOTECH BORING	0
3015	3020	0	0.DUMMY	0
3020	3025270		40000.CCC-EGD GEOTECH DESIGN	0
3020	3030	90	65000.CCC-EHA HYDRAULIC DESIGN	0
3025	3030	0	0.DUMMY	0
3030	3035	90	70000.CCC-EGE GENERAL ENGR	0
3035	3040	60	10000.CCC-EDD PLANS	0
3035	3045	60	20000.CCC-ESP SPECIFICATIONS	0
3040	3045	0	0.DUMMY	0
3045	3050	30	5000.CCC-EDE ESTIMATE	0
3050	5000	0	0.DUMMY	0
-999	-999			0

EOT..

Figure 5.3-4: Input file created by option 1  
for multiple project analysis.

## SECTION 6. OUTPUT DISPLAYS

### 6.1 General

The output from \*CPM consists of sorted CPM computations, Gantt Charts, a resource histogram based on the Gantt Chart, and an accumulated daily cost curve based on the resource histogram. \*CPM will compute the following elements from the network input data:

- a. Early start date (ES).
- b. Early finish date (EF).
- c. Late start date (LS).
- d. Late finish date (LF).
- e. Total slack (TS).
- f. Remaining slack (RS).
- g. Total project cost.

From updated input data, the program can perform the following functions:

- a. Compute total cost to date for each project activity and show total project cost to date.
- b. Show percentage of completion for each project activity.
- c. Replace ES and LS dates with actual start date and alter slack calculations to show how critical the activities are.
- d. Replace LF date with milestone date, alter slack calculations, and determine if milestone can be met.
- e. If a milestone cannot be met, a warning statement is printed, and TS is shown as a negative number which indicates the number of days that the activity will be late if neither the duration nor the milestone is changed.

The program has the ability to sort the output and list it in several orders. The various sorts and their management uses are as follows:

- a. I-J Sort - Activities are listed in numerical order of their I-J (event) numbers. Analysis of this sort allows the logic of the total network to be checked and the level of input accuracy to be quickly determined.

b. Early Start Sort - Activities are listed in chronological order by their ES dates. This sort shows which activities can be started chronologically if resources are available.

c. Early Finish Sort - Activities are listed chronologically by their EF dates. This sort shows how soon activities can be finished if resources are available.

d. Late Start Sort - Activities are listed chronologically by their LS dates. This sort shows when activities must be started to remain on schedule.

e. Late Finish Sort - Activities are listed chronologically by their LF date. This is one of the most important sorts from a management standpoint. It shows which activities must be completed to avoid missing milestones. In the final output, the LF dates will be replaced by the activity milestone date. Therefore, this sort could be labeled the milestone sort.

f. Total Slack Sort - Activities are listed in ascending numerical order by their amounts of total slack. This is the most important management sort because it shows the critical activities and near-critical activities.

g. Project Sort - Activities are listed in the order specified by any of the above five basic sorts for one specific project. This allows project managers to get information on a particular project.

h. Organization Sort - All the activities of a specific organization are listed in the order specified by any of the six basic sorts. This provides specific information on the work schedule of a particular organization to allow evaluation of bottlenecks and analysis of staffing levels.

## 6.2 Single Project Example

Figure 6.2-1 shows the output generated by option 5 sorted in the six basic sorts discussed above. Figure 6.2-2 is the plot file developed in option 5. Figure 6.2-3 is the Gantt Chart generated in option 6 from the option 5 plot file. A daily cost file is created in option 6 (figure 6.2-4), and these data are used to generate a resource histogram (figure 6.2-5) and an accumulated daily cost curve (figure 6.2-6). The resource histogram shows two situations:

a. The resource requirement if every activity is scheduled to begin on its ES date (shown by a solid line).

b. The resource requirement if every activity is scheduled to begin on its LS date (shown by a dashed line). The accumulated daily cost curve shows the same two situations.

I-J SORT

UPDATE AS OF 10 583

EXAMPLE FOR RCPM  
 USERS MANUAL OF A SINGLE  
 PROJECT/NETWORK AND ITS INPUT AND OUTPUT FILES

6 MAY 83

0	EVENT	DUR	ACTIVITY DESCRIPTION	TOTAL COST	CURRENT COST	PCT COMP	EARLIEST		LATEST		SLACK TOT
							START	FINISH	START	FINISH	
1010	1015	90	AAA-END HYDROLOGY	25000.	0.	0	10CT83	30DEC83	10CT83	30DEC83	0 0
1010	1020	30	AAA-EG8 GEOTECH BORINGS	25000.	0.	0	10CT83	31OCT83	30NOV83	30DEC83	60 60
1015	1020	0	DUMMY	0.	0.	0	30DEC83	30DEC83	30DEC83	30DEC83	0 0
1020	1025	90	AAA-EHA HYDRAULIC DES	65000.	0.	0	30DEC83	29MAR84	27JUN84	25SEP84	180 180
1020	1030	270	AAA-EG0 GEOTECH DES	40000.	0.	0	30DEC83	25SEP84	30DEC83	25SEP84	0 0
1025	1030	0	DUMMY	0.	0.	0	29MAR84	29MAR84	25SEP84	25SEP84	180 180
1025	1035	90	AAA-EGE GENERAL ENGR	70000.	0.	0	29MAR84	27JUN84	25SEP84	24DEC84	180 180
1030	1035	90	AAA-ED8 STRUCTURAL DES	30000.	0.	0	25SEP84	24DEC84	25SEP84	24DEC84	0 0
1035	1040	60	AAA-EDD PLANS	10000.	0.	0	24DEC84	22FEB85	24DEC84	22FEB85	0 0
1035	1045	60	AAA-ESP SPECIFICATIONS	20000.	0.	0	24DEC84	22FEB85	24DEC84	22FEB85	0 0
1040	1045	0	DUMMY	0.	0.	0	22FEB85	22FEB85	22FEB85	22FEB85	0 0
1045	1050	30	AAA-ED8 ESTIMATE	5000.	0.	0	22FEB85	24MAR85	22FEB85	24MAR85	0 0

TOTAL COST OF WORK: 290000.  
 TOTAL COST OF WORK COMPLETED: 0.

\* INDICATES ACTUAL START  
 ## INDICATES MILESTONE DATE

1 LATE START SORT  
 1 UPDATE AS OF

EXAMPLE FOR RCPH 6 MAY 83

USERS MANUAL OF A SINGLE  
 PROJECT/NETWORK AND ITS INPUT AND OUTPUT FILES

0	EVENT	DUR	ACTIVITY DESCRIPTION	TOTAL COST	CURRENT COST	PCT COMP	EARLIEST		LATEST		SLACK TOT
							START	FINISH	START	FINISH	
1010	1015	90	AAA-END HYDROLOGY	25000.	0.	0	10CT83	30DEC83	10CT83	30DEC83	0 0
1010	1020	30	AAA-EG8 GEOTECH BORINGS	25000.	0.	0	10CT83	31OCT83	30NOV83	30DEC83	60 60
1015	1020	0	DUMMY	0.	0.	0	30DEC83	30DEC83	30DEC83	30DEC83	0 0
1020	1030	270	AAA-EG0 GEOTECH DES	40000.	0.	0	30DEC83	25SEP84	30DEC83	25SEP84	0 0
1020	1025	90	AAA-EHA HYDRAULIC DES	65000.	0.	0	30DEC83	29MAR84	27JUN84	25SEP84	180 180
1025	1030	0	DUMMY	0.	0.	0	29MAR84	29MAR84	25SEP84	25SEP84	180 180
1025	1035	90	AAA-EGE GENERAL ENGR	70000.	0.	0	29MAR84	27JUN84	25SEP84	24DEC84	180 180
1030	1035	90	AAA-ED8 STRUCTURAL DES	30000.	0.	0	25SEP84	24DEC84	25SEP84	24DEC84	0 0
1035	1040	60	AAA-EDD PLANS	10000.	0.	0	24DEC84	22FEB85	24DEC84	22FEB85	0 0
1035	1045	60	AAA-ESP SPECIFICATIONS	20000.	0.	0	24DEC84	22FEB85	24DEC84	22FEB85	0 0
1040	1045	0	DUMMY	0.	0.	0	22FEB85	22FEB85	22FEB85	22FEB85	0 0
1045	1050	30	AAA-ED8 ESTIMATE	5000.	0.	0	22FEB85	24MAR85	22FEB85	24MAR85	0 0

TOTAL COST OF WORK: 290000.  
 TOTAL COST OF WORK COMPLETED: 0.

\* INDICATES ACTUAL START  
 ## INDICATES MILESTONE DATE

Figure 6.2-1: CPM printed output file generated by option 5.

EARLY START SORT  
1 UPDATE AS OF

EXAMPLE FOR 8CPM

6 MAY 83

USERS MANUAL OF A SINGLE PROJECT/NETWORK AND ITS INPUT AND OUTPUT FILES

0	EVENT	DUR	ACTIVITY DESCRIPTION	TOTAL COST	CURRENT			EARLIEST		LATEST		SLACK TOT REM
					I	J	ATION	COST	COMP	START	FINISH	
1010	1015	90	AAA-EHO HYDROLOGY	25000.	0.	0	10CT83	300EC83	10CT83	300EC83	0	0
1010	1020	30	AAA-EG8 GEOTECH BORINGS	25000.	0.	0	10CT83	310CT83	30NOV83	30DEC83	60	60
1015	1020	0	DUMMY	0.	0.	0	300EC83	300EC83	30DEC83	30DEC83	0	0
1020	1025	90	AAA-EHA HYDRAULIC DES	65000.	0.	0	300EC83	29MAR84	27JUN84	25SEP84	180	180
1020	1030	270	AAA-EG0 GEOTECH DES	40000.	0.	0	300CC83	25SEP84	30EC83	25SEP84	0	0
1025	1030	0	DUMMY	0.	0.	0	29MAR84	29MAR84	25SEP84	25SEP84	180	180
1025	1035	90	AAA-EGE GENERAL ENGR	70000.	0.	0	29MAR84	27JUN84	25SEP84	24DEC84	180	180
1030	1035	90	AAA-ED5 STRUCTURAL DES	30000.	0.	0	25SEP84	24DEC84	25SEP84	24DEC84	0	0
1035	1040	60	AAA-ED0 PLANS	10000.	0.	0	24DEC84	22FEB85	24DEC84	22FEB85	0	0
1035	1045	60	AAA-ESP SPECIFICATIONS	20000.	0.	0	24DEC84	22FEB85	24DEC84	22FEB85	0	0
1040	1045	0	DUMMY	0.	0.	0	22FEB85	22FEB85	22FEB85	22FEB85	0	0
1045	1050	30	AAA-EDE ESTIMATE	5000.	0.	0	22FEB85	24MAR85	22FEB85	24MAR85	0	0

TOTAL COST OF WORK: 290000.  
TOTAL COST OF WORK COMPLETED: 0.

\* INDICATES ACTUAL START  
\*\* INDICATES MILESTONE DATE

1  
EARLY FINISH SORT  
1 UPDATE AS OF

EXAMPLE FOR 8CPM

6 MAY 83

USERS MANUAL OF A SINGLE PROJECT/NETWORK AND ITS INPUT AND OUTPUT FILES

0	EVENT	DUR	ACTIVITY DESCRIPTION	TOTAL COST	CURRENT			EARLIEST		LATEST		SLACK TOT REM
					I	J	ATION	COST	COMP	START	FINISH	
1010	1020	30	AAA-EG8 GEOTECH BORINGS	25000.	0.	0	10CT83	310CT83	30NOV83	30DEC83	60	60
1010	1015	90	AAA-EHO HYDROLOGY	25000.	0.	0	10CT83	300EC83	10CT83	300EC83	0	0
1015	1020	0	DUMMY	0.	0.	0	300EC83	300EC83	30DEC83	30DEC83	0	0
1020	1025	90	AAA-EHA HYDRAULIC DES	65000.	0.	0	300EC83	29MAR84	27JUN84	25SEP84	180	180
1025	1030	0	DUMMY	0.	0.	0	29MAR84	29MAR84	25SEP84	25SEP84	180	180
1025	1035	90	AAA-EGE GENERAL ENGR	70000.	0.	0	29MAR84	27JUN84	25SEP84	24DEC84	180	180
1030	1035	270	AAA-EG0 GEOTECH DES	40000.	0.	0	300CC83	25SEP84	30EC83	25SEP84	0	0
1030	1035	90	AAA-ED5 STRUCTURAL DES	30000.	0.	0	25SEP84	24DEC84	25SEP84	24DEC84	0	0
1035	1040	60	AAA-ED0 PLANS	10000.	0.	0	24DEC84	22FEB85	24DEC84	22FEB85	0	0
1035	1045	60	AAA-ESP SPECIFICATIONS	20000.	0.	0	24DEC84	22FEB85	24DEC84	22FEB85	0	0
1040	1045	0	DUMMY	0.	0.	0	22FEB85	22FEB85	22FEB85	22FEB85	0	0
1045	1050	30	AAA-EDE ESTIMATE	5000.	0.	0	22FEB85	24MAR85	22FEB85	24MAR85	0	0

TOTAL COST OF WORK: 290000.  
TOTAL COST OF WORK COMPLETED: 0.

\* INDICATES ACTUAL START  
\*\* INDICATES MILESTONE DATE

1

Figure 6.2-1: CPM printed output file generated by option 5 (continued).

LATE FINISH SORT  
1 UPDATE AS OF

EXAMPLE FOR #CPM

6 MAY 83

USERS MANUAL OF A SINGLE  
PROJECT-NETWORK AND ITS INPUT AND OUTPUT FILES

0	EVENT	DUR	ACTIVITY DESCRIPTION	TOTAL COST	CURRENT COST	PCT COMP	EARLIEST START	LATEST FINISH	SLACK TOT REM
	I	J	ATION						
1010	1015	90	AAA-EHO HYDROLOGY	25000.	0.	0	10CT83	30DEC83	10CT83 30DEC83 0 0
1010	1020	30	AAA-ECB GEOTECH BORINGS	25000.	0.	0	10CT83	31OCT83	30NOV83 30DEC83 60 60
1015	1020	0	DUMMY	0.	0.	0	30DEC83	30DEC83	30DEC83 0 0
1020	1025	90	AAA-EHA HYDRAULIC DES	65000.	0.	0	30DEC83	29MAR84	27JUN84 25SEP84 180 180
1020	1030	270	AAA-EGD GEOTECH DES	40000.	0.	0	30DEC83	25SEP84	30DEC83 25SEP84 0 0
1025	1030	0	DUMMY	0.	0.	0	29MAR84	29MAR84	25SEP84 25SEP84 180 180
1025	1035	90	AAA-EGE GENERAL ENGR	70000.	0.	0	29MAR84	27JUN84	25SEP84 24DEC84 180 180
1030	1035	90	AAA-EDS STRUCTURAL DES	30000.	0.	0	25SEP84	24DEC84	25SEP84 24DEC84 0 0
1035	1040	60	AAA-EDO PLANS	10000.	0.	0	24DEC84	22FEB85	24DEC84 22FEB85 0 0
1035	1045	60	AAA-ESP SPECIFICATIONS	20000.	0.	0	24DEC84	22FEB85	24DEC84 22FEB85 0 0
1040	1045	0	DUMMY	0.	0.	0	22FEB85	22FEB85	22FEB85 0 0
1045	1050	30	AAA-EDE ESTIMATE	5000.	0.	0	22FEB85	24MAR85	22FEB85 24MAR85 0 0

TOTAL COST OF WORK: 290000.  
TOTAL COST OF WORK COMPLETED: 0.

\* INDICATES ACTUAL START  
\*\* INDICATES MILESTONE DATE

1 TOTAL SLACK SORT  
1 UPDATE AS OF

EXAMPLE FOR #CPM

6 MAY 83

USERS MANUAL OF A SINGLE  
PROJECT-NETWORK AND ITS INPUT AND OUTPUT FILES

0	EVENT	DUR	ACTIVITY DESCRIPTION	TOTAL COST	CURRENT COST	PCT COMP	EARLIEST START	LATEST FINISH	SLACK TOT REM
	I	J	ATION						
1010	1015	90	AAA-EHO HYDROLOGY	25000.	0.	0	10CT83	30DEC83	10CT83 30DEC83 0 0
1015	1020	0	DUMMY	0.	0.	0	30DEC83	30DEC83	30DEC83 0 0
1020	1030	270	AAA-EGD GEOTECH DES	40000.	0.	0	30DEC83	25SEP84	30DEC83 25SEP84 0 0
1030	1035	90	AAA-EDS STRUCTURAL DES	30000.	0.	0	25SEP84	24DEC84	25SEP84 24DEC84 0 0
1035	1040	60	AAA-EDO PLANS	10000.	0.	0	24DEC84	22FEB85	24DEC84 22FEB85 0 0
1035	1045	60	AAA-ESP SPECIFICATIONS	20000.	0.	0	24DEC84	22FEB85	24DEC84 22FEB85 0 0
1040	1045	0	DUMMY	0.	0.	0	22FEB85	22FEB85	22FEB85 0 0
1045	1050	30	AAA-EDE ESTIMATE	5000.	0.	0	22FEB85	24MAR85	22FEB85 24MAR85 0 0
1010	1020	30	AAA-ECB GEOTECH BORINGS	25000.	0.	0	10CT83	31OCT83	30NOV83 30DEC83 60 60
1020	1025	90	AAA-EHA HYDRAULIC DES	65000.	0.	0	30DEC83	29MAR84	27JUN84 25SEP84 180 180
1025	1030	0	DUMMY	0.	0.	0	29MAR84	29MAR84	25SEP84 25SEP84 180 180
1025	1035	90	AAA-EGE GENERAL ENGR	70000.	0.	0	29MAR84	27JUN84	25SEP84 24DEC84 180 180

TOTAL COST OF WORK: 290000.  
TOTAL COST OF WORK COMPLETED: 0.

\* INDICATES ACTUAL START  
\*\* INDICATES MILESTONE DATE

EDT..

Figure 6.2-1: CPM printed output file generated by option 5 (continued).

EXAMPLE FOR \*CPM                    6 MAY 83  
 USERS MANUAL OF A SINGLE  
 PROJECT/NETWORK AND ITS INPUT AND OUTPUT FILES  
 AAA-EHO HYDROLOGY                10 18312308310 183123083      25000.  
 AAA-EGB GEOTECH BORINGS        10 183103183113083123083      25000.  
 DUMMY                             123083123083123083123083      0.  
 AAA-EHA HYDRAULIC DES        123083 32984 62784 92584      65000.  
 AAA-EGO GEOTECH DES            123083 92584123083 92584      40000.  
 DUMMY                             32984 32984 92584 92584      0.  
 AAA-EGE GENERAL ENGR          32984 62784 92584122484      70000.  
 AAA-EDS STRUCTURAL DES        92584122484 92584122484      30000.  
 AAA-EDO PLANS                   122484 22285122484 22285      10000.  
 AAA-ESP SPECIFICATIONS        122484 22285122484 22285      20000.  
 DUMMY                             22285 22285 22285 22285      0.  
 AAA-EDE ESTIMATE                22285 32485 22285 32485      5000.  
 EOT ..

**Figure 6.2-2:** Plot file developed in  
 option 5 for single project  
 example.

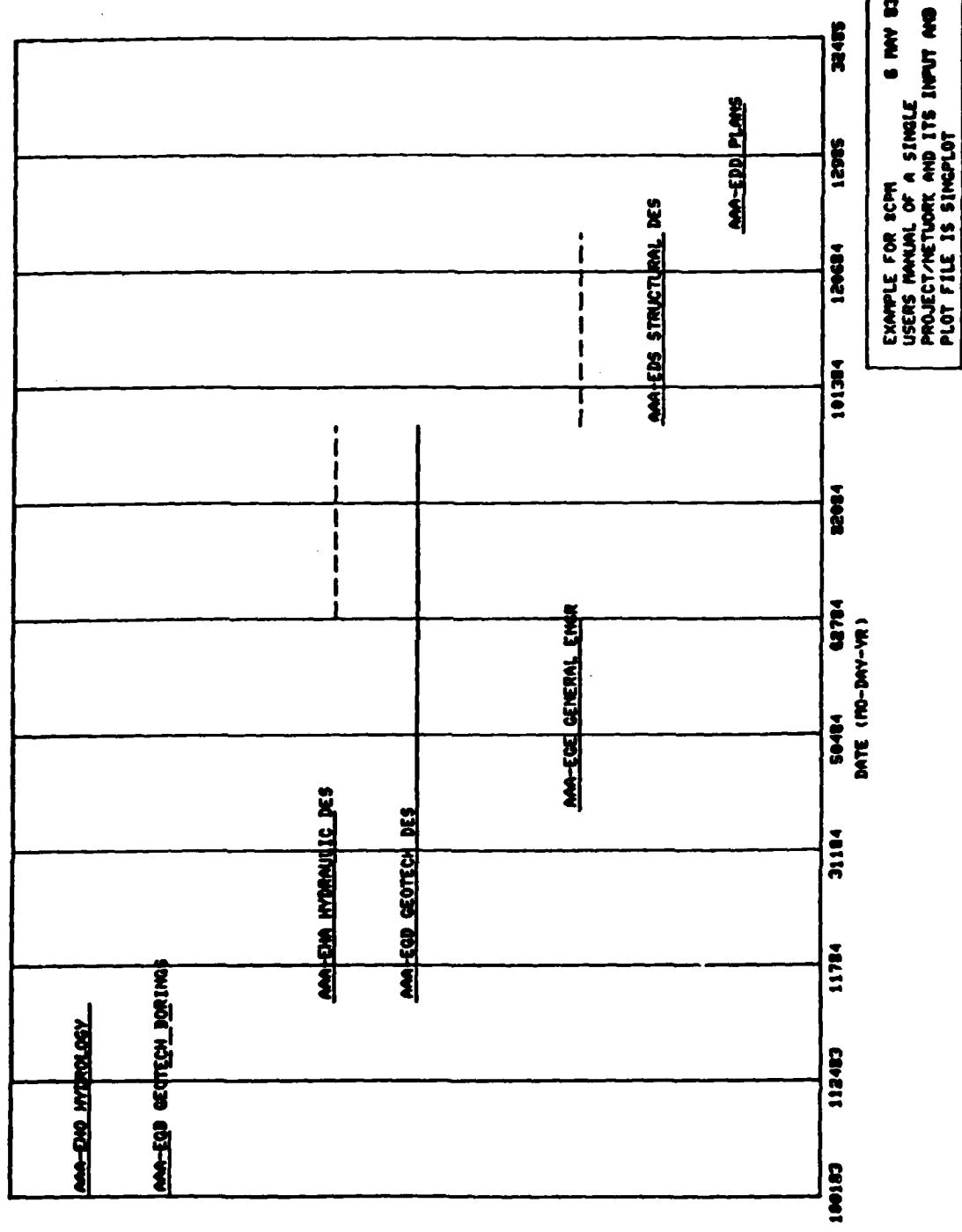


Figure 6.2-3: Single project Gantt Chart.

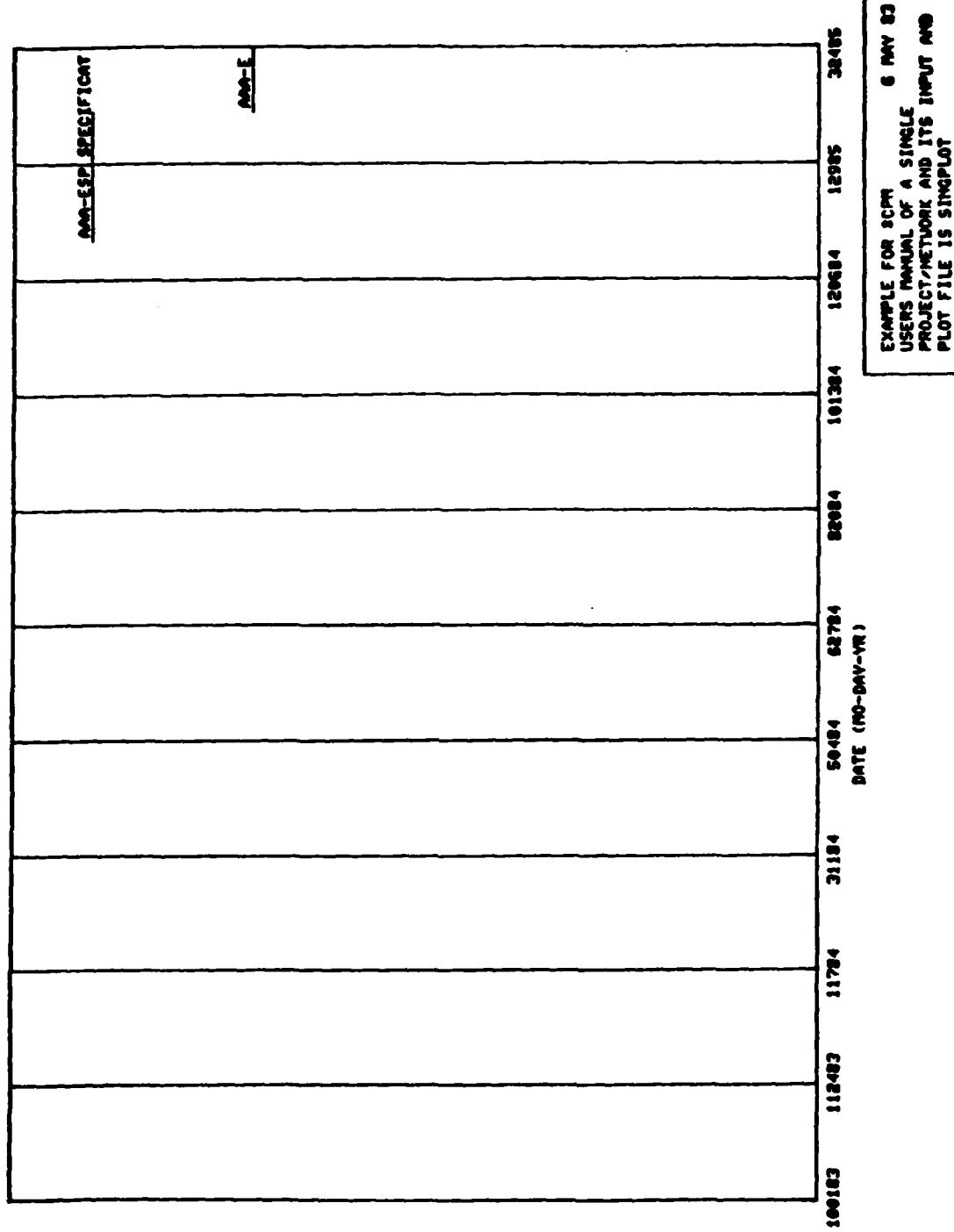


Figure 6.2-3: Single project Gantt Chart (continued).

EXAMPLE FOR #CPM 6 MAY 83  
 USERS MANUAL OF A SINGLE PROJECT-NETWORK AND ITS INPUT AND

AVERAGE DAILY COST SUMMARY

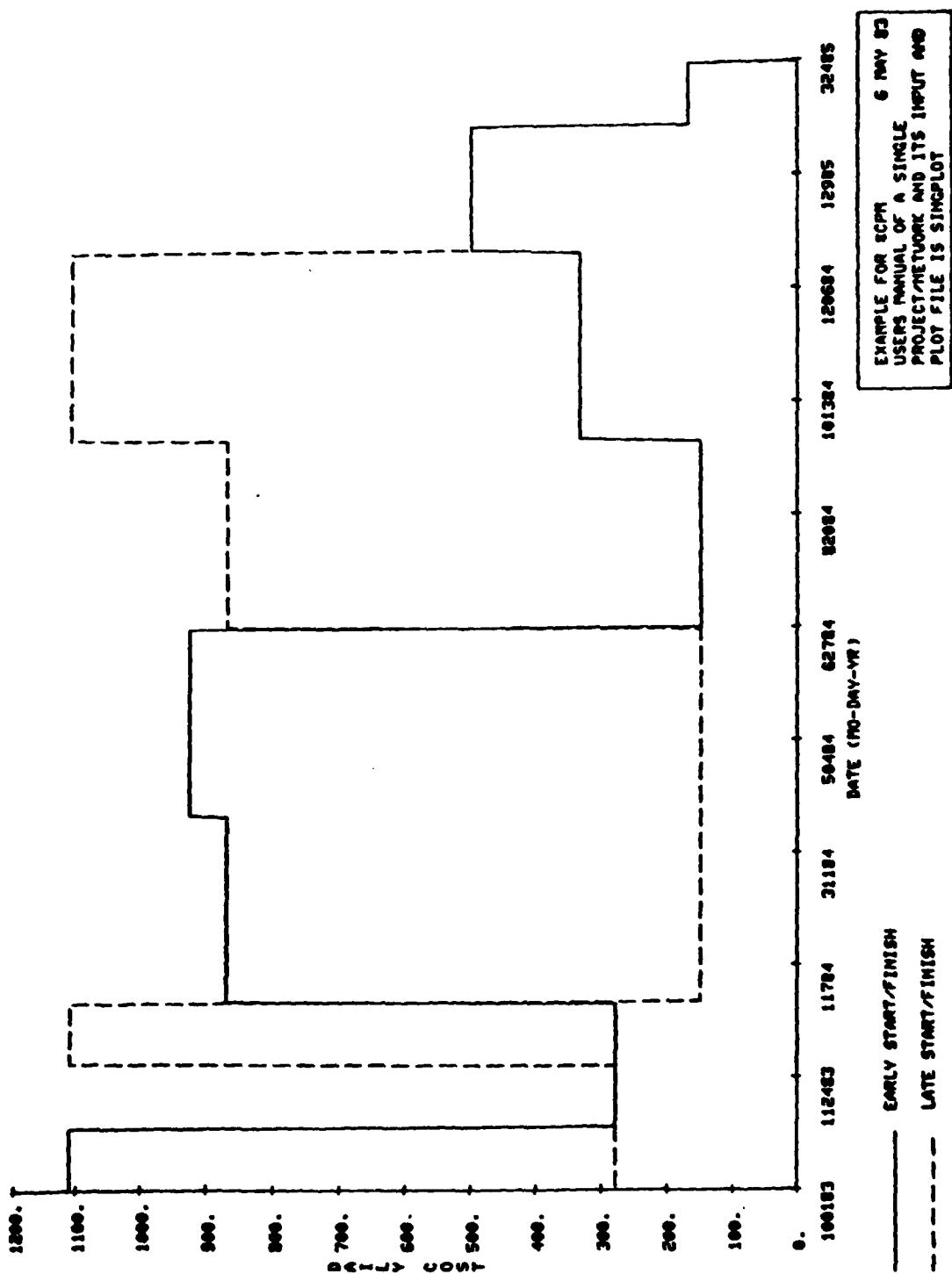
DATE	EARLY START/FINISH COST	LATE START/FINISH COST
100183	1111.	278.
100283	1111.	278.
100383	1111.	278.
100483	1111.	278.
100583	1111.	278.
100683	1111.	278.
100783	1111.	278.
100883	1111.	278.
100983	1111.	278.
101083	1111.	278.
101183	1111.	278.
101283	1111.	278.
101383	1111.	278.
101483	1111.	278.
101583	1111.	278.
101683	1111.	278.
101783	1111.	278.
101883	1111.	278.
101983	1111.	278.
102083	1111.	278.
102183	1111.	278.
102283	1111.	278.
102383	1111.	278.
102483	1111.	278.
102583	1111.	278.
102683	1111.	278.
102783	1111.	278.
102883	1111.	278.
102983	1111.	278.
103083	1111.	278.
103183	278.	278.
110183	278.	167.
110283	278.	167.
110383		167.
110483		167.
110583		167.
110683		167.
110783	167.	167.
110883	167.	167.
110983	167.	167.
111083	167.	167.
111183	167.	167.
111283	167.	167.
111383	167.	167.
111483	167.	167.
111583	167.	167.
111683	167.	167.
111783	167.	167.
111883	167.	167.
111983	167.	167.
112083	167.	167.
112183	167.	167.
112283	167.	167.
112383	167.	167.
112483	167.	167.
112583	167.	167.
112683	167.	167.
112783	167.	167.
112883	167.	167.
112983	167.	167.
113083	167.	167.
032085	167.	0.
032185	167.	0.
032285	167.	0.
032385	167.	0.
032485	167.	0.

MAXIMUM DAILY EARLY START/FINISH COST IS \$ 1111. ON 100183.

MAXIMUM DAILY LATE START/FINISH COST IS \$ 1111. ON 113083.

EOT..

Figure 6.2-4: Daily cost file created in option 6 for single project example (partial listing).



**Figure 6.2-5:** Single project resource histogram.

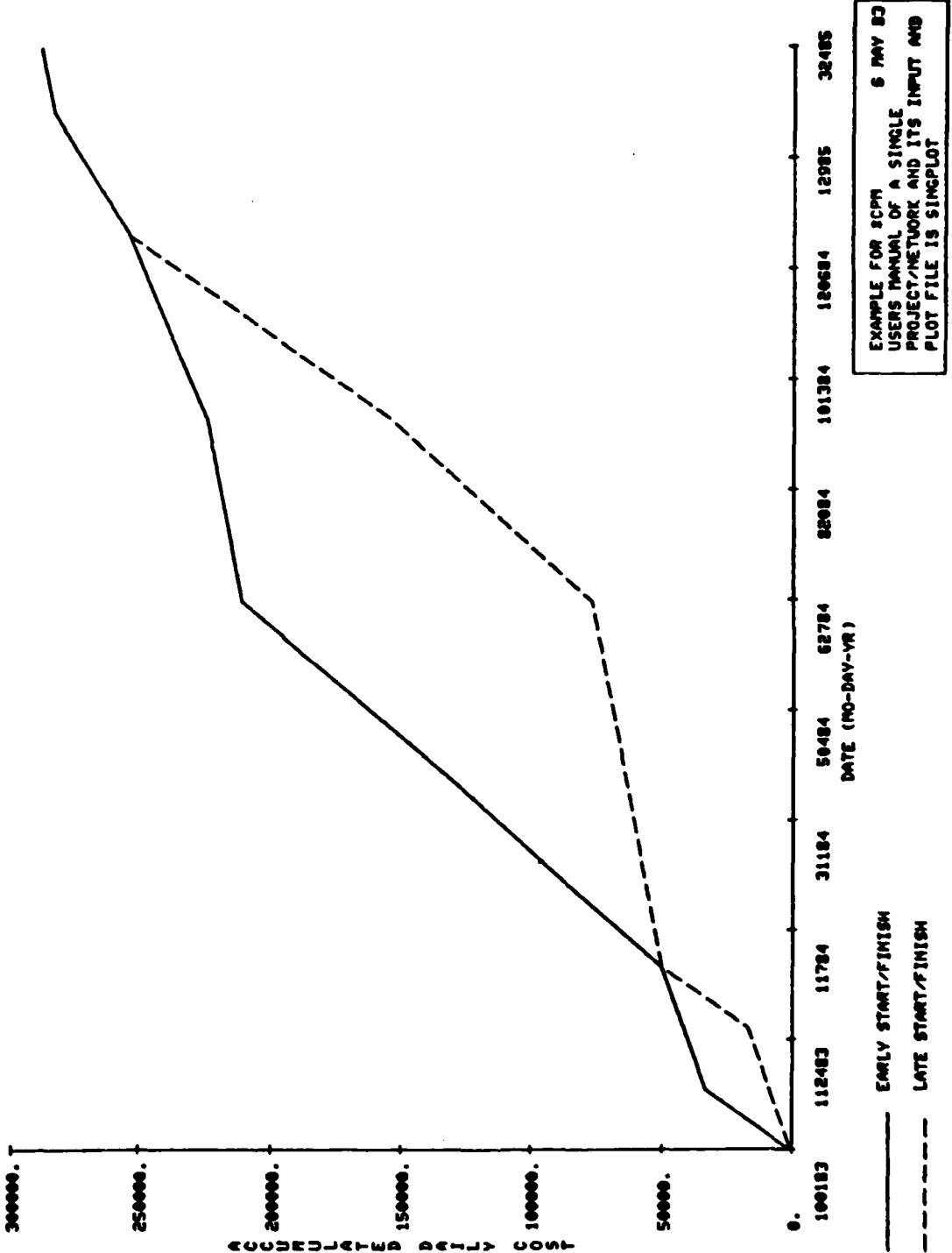


Figure 6.2-6: Accumulated daily cost curve for single project example.

Resources are leveled by iterating through options 2, 3, 5, 6, and 7 and assigning actual start dates and changing milestones to move activities back and forth through time.

### 6.3 Multiple Project Example

Figure 6.3-1 shows the I-J sort of the CPM printed output file generated by option 5. Figure 6.3-2 is the plot file created in option 5. Figures 6.3-3, 6.3-4, and 6.3-5 are all generated using option 6.

## SECTION 7. RA/PM INTERFACE

To avoid maintaining two separate data bases for the same information, option 10 of the \*CPM (an interface program) takes the option 3 output file and reconfigures its format to create a RA/PM input file. To do this, the user must use option 8 in the project code search mode and create an individual input file for each project. These files are then run through option 3 to create an output file, and this file is run through option 10, where additional administrative input is added and the file's format is reconfigured. Once this has been done, the option 10 output file can be used for input directly into the RA/PM system.

I-J SORT

1 UPDATE AS OF 10 583

5

I-J SORT

EXAMPLE OF MULTIPLE  
PROJECT ANALYSIS FOR CPM

6 MAY 83

USERS MANUAL

0	EVENT	DUR	ACTIVITY DESCRIPTION	TOTAL COST	CURRENT COST	PCT COMP	EARLIEST START	LATEST START	SLACK TOT REM
	I	J	ATION						
1	1010	0	DUMMY	0.	0.	0	10CT83	10CT83	0 0
1	2010	0	DUMMY	0.	0.	0	10CT83	10CT83	60 60
1	3010	0	DUMMY	0.	0.	0	10CT83	10CT83	0 0
1010	1015	90	AAA-EHO HYDROLOGY	25000.	0.	0	10CT83	30DEC83	0 0
1010	1020	30	AAA-EG8 GEOTECH BORING	25000.	0.	0	10CT83	31OCT83	30NOV83 30DEC83
1015	1020	0	DUMMY	0.	0.	0	30DEC83	30DEC83	0 0
1020	1025	90	AAA-EHA HYDRAULIC DESIGN	65000.	0.	0	30DEC83	27JUN84	25SEP84 180 180
1020	1030	270	AAA-EGD GEOTECH DESIGN	40000.	0.	0	30DEC83	25SEP84	30DEC03 25SEP84
1025	1030	0	DUMMY	0.	0.	0	29MAR84	29MAR84	25SEP84 180 180
1025	1035	90	AAA-EGE GENERAL ENGR	70000.	0.	0	29MAR84	27JUN84	25SEP84 24DEC84
1030	1035	90	AAA-EDS STRUCTURAL DESIGN	30000.	0.	0	25SEP84	24DEC84	25SEP84 24DEC84
1035	1040	60	AAA-EDD PLANS	10000.	0.	0	24DEC84	22FEB85	24DEC84 22FEB85
1035	1045	60	AAA-ESP SPECIFICATIONS	20000.	0.	0	24DEC84	22FEB85	24DEC84 22FEB85
1040	1045	0	DUMMY	0.	0.	0	22FEB85	22FEB85	22FEB85 22FEB85
1045	1050	30	ESTIMATE	5000.	0.	0	22FEB85	24MAR85	22FEB85 24MAR85
1050	5000	0	DUMMY	0.	0.	0	24MAR85	24MAR85	0 0
2010	2015	30	BBB-EG8 GEOTECH BORING	25000.	0.	0	10CT83	31OCT83	30NOV83 30DEC83
2015	2020	270	BBB-EGD GEOTECH DESIGN	40000.	0.	0	31OCT83	27JUL84	30DEC83 25SEP84
2015	2025	30	BBB-EDS STRUCTURAL DESIGN	10000.	0.	0	31OCT83	30NOV83	10SEP84 10OCT84
2020	2025	0	DUMMY	0.	0.	0	27JUL84	27JUL84	10OCT84 10OCT84
2020	2040	90	BBB-EGE GENERAL ENGR	70000.	0.	0	27JUL84	25OCT84	25SEP84 24DEC84
2025	2030	60	BBB-ED5 STRUCTURAL DESIGN	20000.	0.	0	27JUL84	25SEP84	10OCT84 9DEC84
2025	2035	60	BBB-EDN NON-STRUCTURAL DESIGN	10000.	0.	0	27JUL84	25SEP84	10OCT84 9DEC84
2030	2035	0	DUMMY	0.	0.	0	25SEP84	25SEP84	9DEC84 9DEC84
2030	2040	0	DUMMY	0.	0.	0	25SEP84	25SEP84	24DEC84 24DEC84
2035	2040	15	BBB-EDN NON-STRUCUTURAL DESIGN	5000.	0.	0	25SEP84	10OCT84	9DEC84 24DEC84
2040	2045	60	BBB-ED0 PLANS	10000.	0.	0	25OCT84	24DEC84	24DEC84 22FEB85
2040	2050	60	BBB-ESP SPECIFICATIONS	20000.	0.	0	25OCT84	24DEC84	24DEC84 22FEB85
2045	2050	0	DUMMY	0.	0.	0	24DEC84	22FEB85	22FEB85 22FEB85
2050	2055	30	BBB-ED6 ESTIMATE	5000.	0.	0	24DEC84	23JAN85	22FEB85 24MAR85
2055	5000	0	DUMMY	0.	0.	0	23JAN85	23JAN85	24MAR85 24MAR85
3010	3015	90	CCC-EHO HYDROLOGY	25000.	0.	0	10CT83	30DEC83	10CT83 30DEC83
3010	3020	30	CCC-EG8 GEOTECH BORING	25000.	0.	0	10CT83	31OCT83	30NOV83 30DEC83
3015	3020	0	DUMMY	0.	0.	0	30DEC83	30DEC83	0 0
3020	3025	270	CCC-EGD GEOTECH DESIGN	40000.	0.	0	30DEC83	25SEP84	30DEC83 25SEP84
3020	3030	90	CCC-EHA HYDRAULIC DESIGN	65000.	0.	0	30DEC83	29MAR84	27JUN84 25SEP84
3025	3030	0	DUMMY	0.	0.	0	25SEP84	25SEP84	25SEP84 25SEP84
3030	3035	90	CCC-EGE GENERAL ENGR	70000.	0.	0	25SEP84	24DEC84	25SEP84 24DEC84
3035	3040	60	CCC-EDD PLANS	10000.	0.	0	24DEC84	22FEB85	24DEC84 22FEB85
3035	3045	60	CCC-ESP SPECIFICATIONS	20000.	0.	0	24DEC84	22FEB85	24DEC84 22FEB85
3040	3045	0	DUMMY	0.	0.	0	22FEB85	22FEB85	22FEB85 22FEB85
3045	3050	30	CCC-ED6 ESTIMATE	5000.	0.	0	22FEB85	24MAR85	22FEB85 24MAR85
3050	5000	0	DUMMY	0.	0.	0	24MAR85	24MAR85	0 0

TOTAL COST OF WORK: 765000.

TOTAL COST OF WORK COMPLETED: 0.

\* INDICATES ACTUAL START

\*\* INDICATES MILESTONE DATE

Figure 6.3-1: Option 5 CPM printed output file for multiple project example.

EXAMPLE OF MULTIPLE 6 MAY 83  
 PROJECT ANALYSIS FOR \*CPM  
 USERS MANUAL

DUMMY	10	18310	18310	18310	183	0
DUMMY	10	18310	18311	30831	113083	0
DUMMY	10	18310	18310	18310	183	0
AAA-EHO HYDROLOGY	10	18312	308310	18312	3083	25000
AAA-EGB GEOTECH BORING	10	183103	18311	308312	3083	25000
DUMMY	123083	1230831	230831	23083	123083	0
AAA-EHA HYDRAULIC DESIGN	123083	32984	62784	92584	92584	65000
AAA-EGO GEOTECH DESIGN	123083	925841	23083	92584	92584	40000
DUMMY	32984	32984	92584	92584	92584	0
AAA-EGE GENERAL ENGR	32984	62784	925841	22484	92584	70000
AAA-EDS STRUCTURAL DESIGN	925841	22484	925841	22484	92584	30000
AAA-EDU PLANS	122484	222851	222484	22285	22285	10000
AAA-ESP SPECIFICATIONS	122484	222851	222484	22285	22285	20000
DUMMY	22285	22285	22285	22285	22285	0
ESTIMATE	22285	32485	22285	32485	32485	5000
DUMMY	32485	32485	32485	32485	32485	0
BBB-ECB GEOTECH BORING	10	183103	18311	308312	3083	25000
BBB-EGD GEOTECH DESIGN	103183	727841	23083	92584	92584	40000
BBB-EDS STRUCTURAL DESIGN	1031831	113083	910841	01084	910841	10000
DUMMY	72784	7278410	108410	108410	1084	0
BBB-EGE GENERAL ENGR	7278410	2584	925841	22484	92584	70000
BBB-EDS STRUCTURAL DESIGN	72784	9258410	08412	984	984	20000
BBB-EDN NON-STRUCTURAL DESIGN	72784	9258410	08412	984	984	10000
DUMMY	92584	9258412	98412	984	984	0
DUMMY	92584	92584122484	92584122484	92584	92584	0
BBB-EDN NON-STRUCUTURAL DESIGN	9258410	108412	984122484	984122484	984122484	5000
BBB-EDD PLANS	1025841	224841	22484	22285	22285	10000
BBB-ESP SPECIFICATIONS	1025841	224841	22484	22285	22285	20000
DUMMY	1224841	22484	22285	22285	22285	0
BBB-EDE ESTIMATE	122484	12385	22285	32485	32485	5000
DUMMY	12385	12385	32485	32485	32485	0
CCC-EHO HYDROLOGY	10	18312	308310	18312	3083	25000
CCC-EGB GEOTECH BORING	10	183103	18311	308312	3083	25000
DUMMY	123083	1230831	230831	23083	123083	0
CCC-EGD GEOTECH DESIGN	123083	925841	23083	92584	92584	40000
CCC-EHA HYDRAULIC DESIGN	123083	32984	62784	92584	92584	65000
DUMMY	92584	92584	92584	92584	92584	0
CCC-EGE GENERAL ENGR	925841	22484	925841	22484	92584	70000
CCC-EDD PLANS	122484	222851	222484	22285	22285	10000
CCC-ESP SPECIFICATIONS	122484	222851	222484	22285	22285	20000
DUMMY	22285	22285	22285	22285	22285	0
CCC-EDE ESTIMATE	22285	32485	22285	32485	32485	5000
DUMMY	32485	32485	32485	32485	32485	0
EOT..						

Figure 6.3-2: Option 5 plot file for multiple project example.

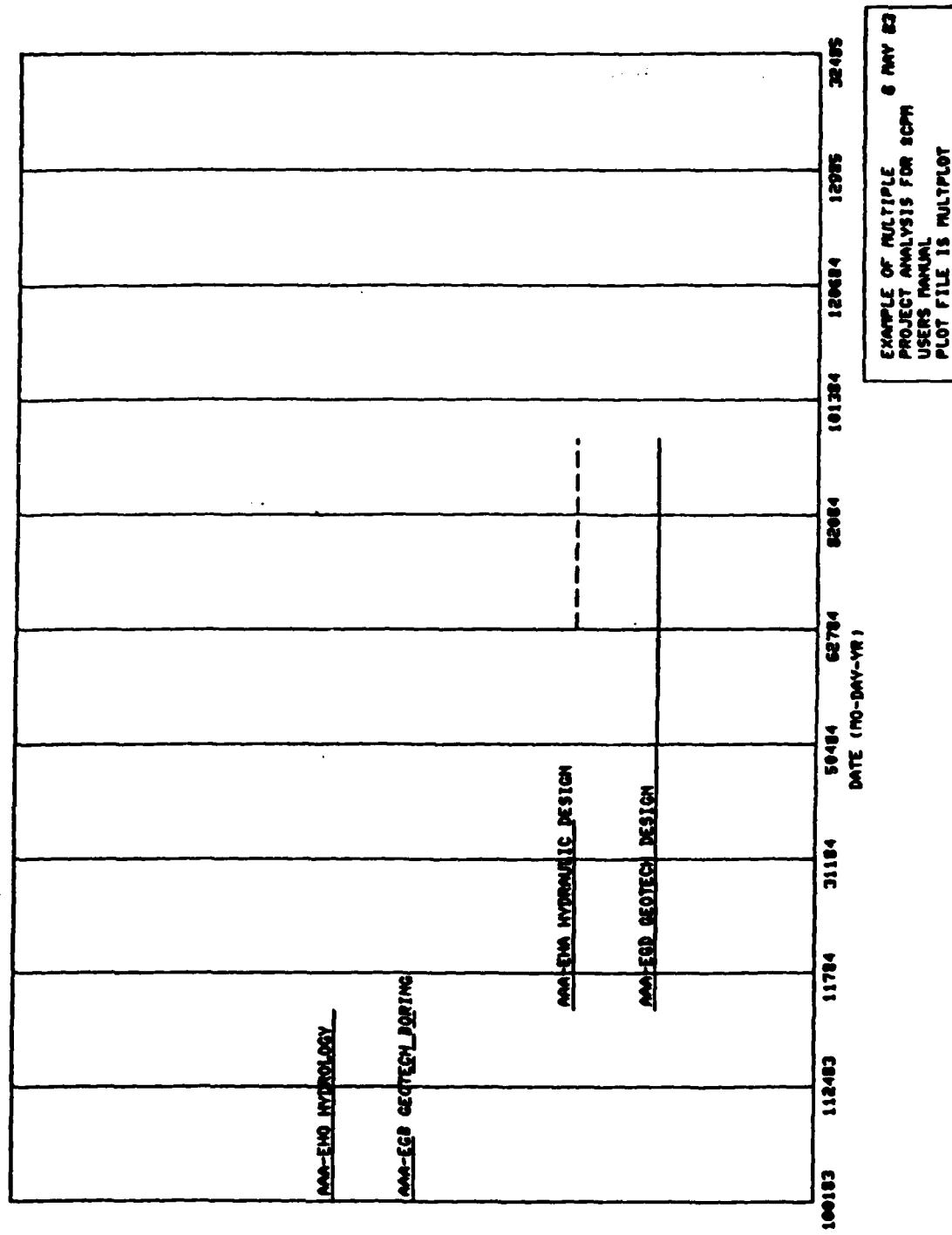


Figure 6.3-3: Option 6 Gantt Chart for multiple project example.

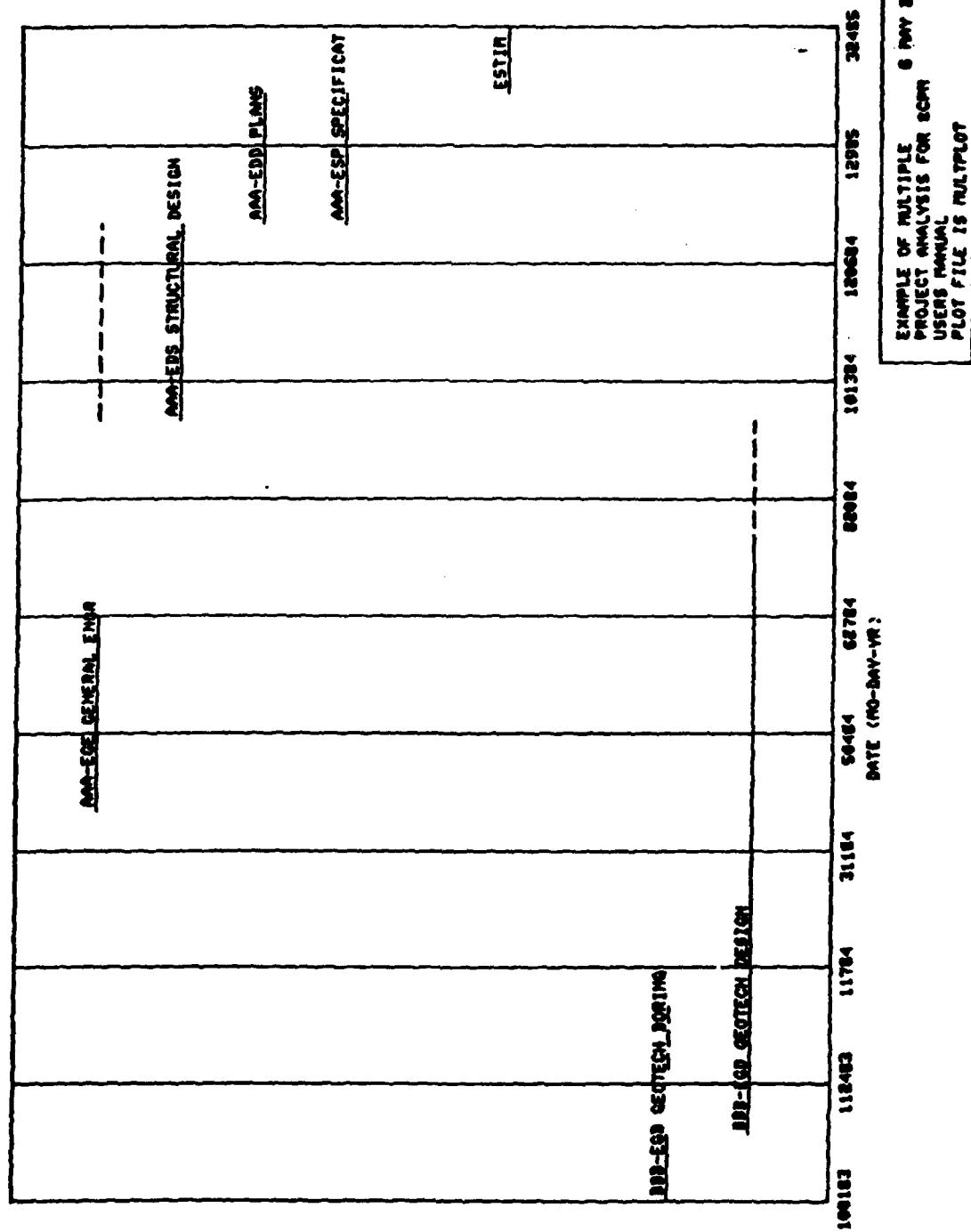


Figure 6.3-3: Option 6 Gantt Chart for multiple project example (continued).

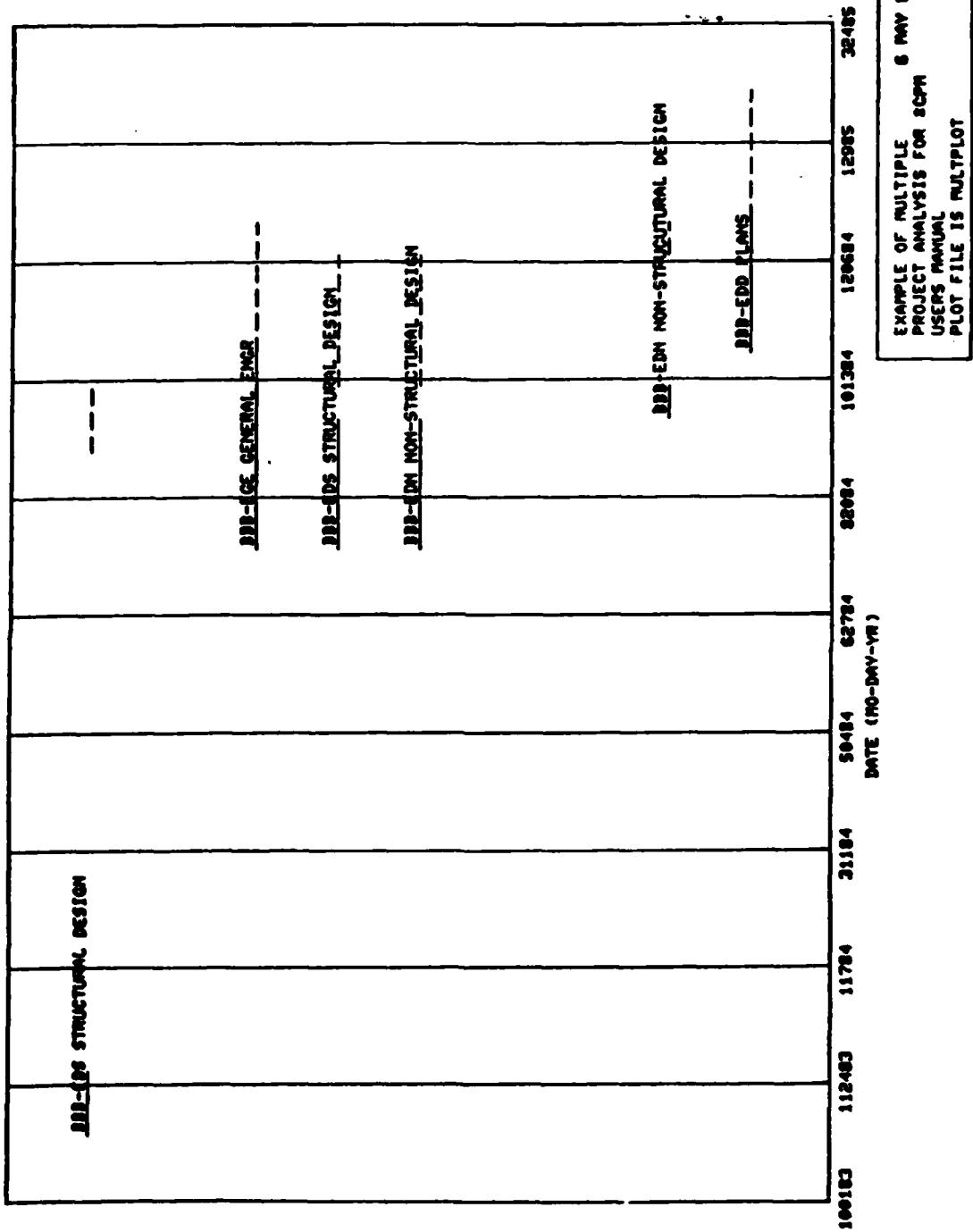


Figure 6.3-3: Option 6 Gantt Chart for multiple project example (continued).

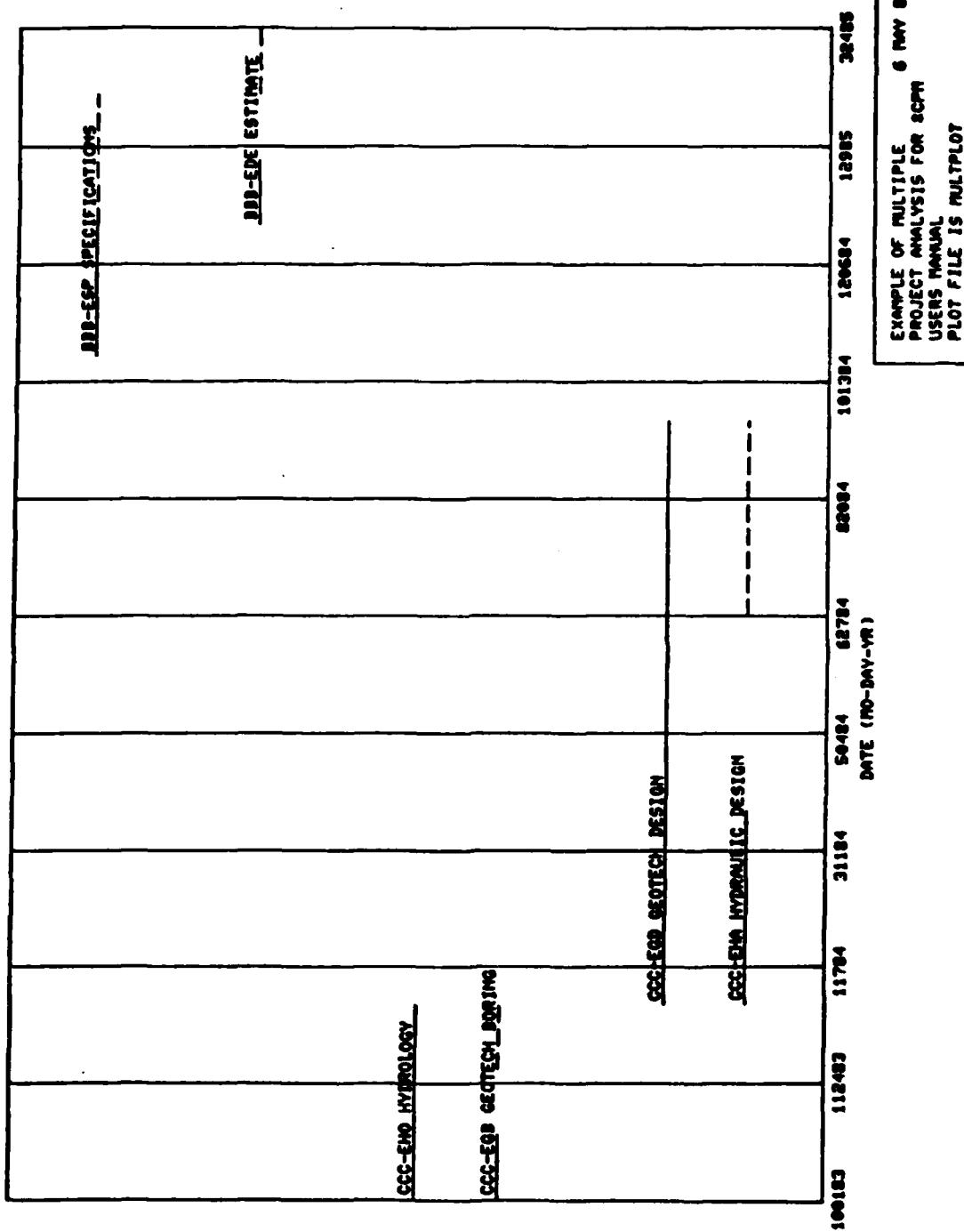


Figure 6.3-3: Option 6 Gantt Chart for multiple project example (continued).

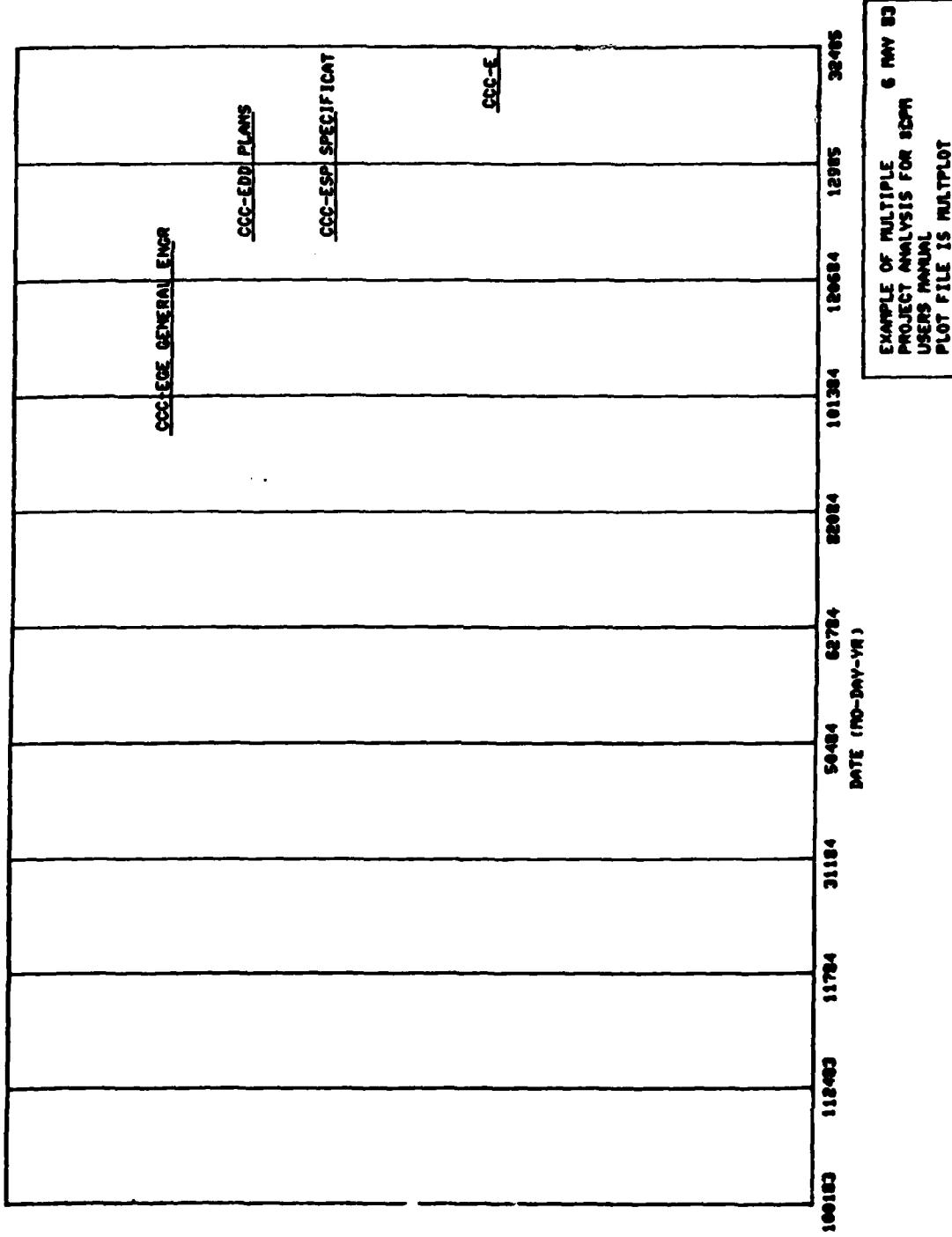


Figure 6.3-3: Option 6 Gantt Chart for multiple project example (continued).

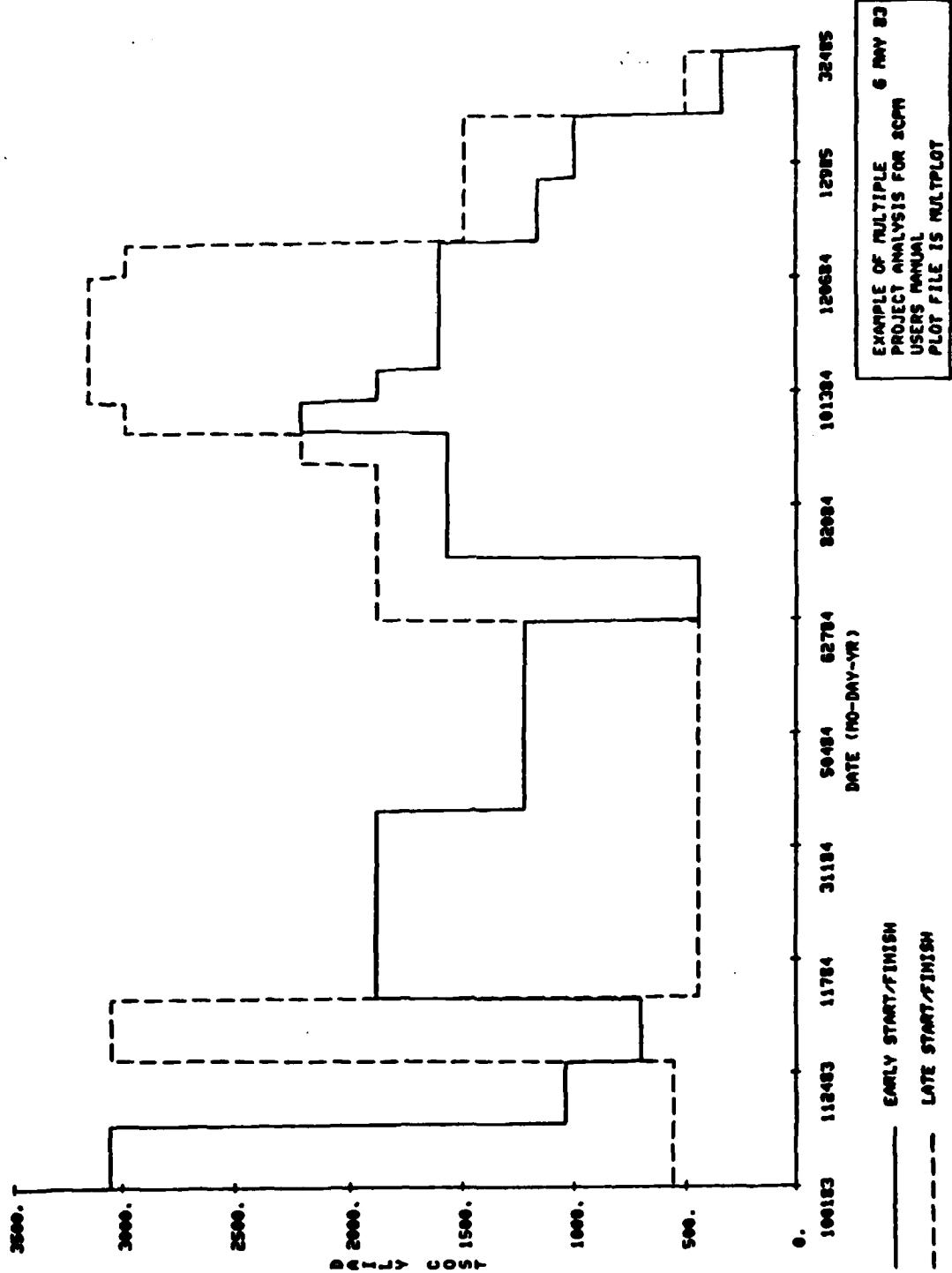


Figure 6.3-4: Option 6 resource histogram for multiple project example.

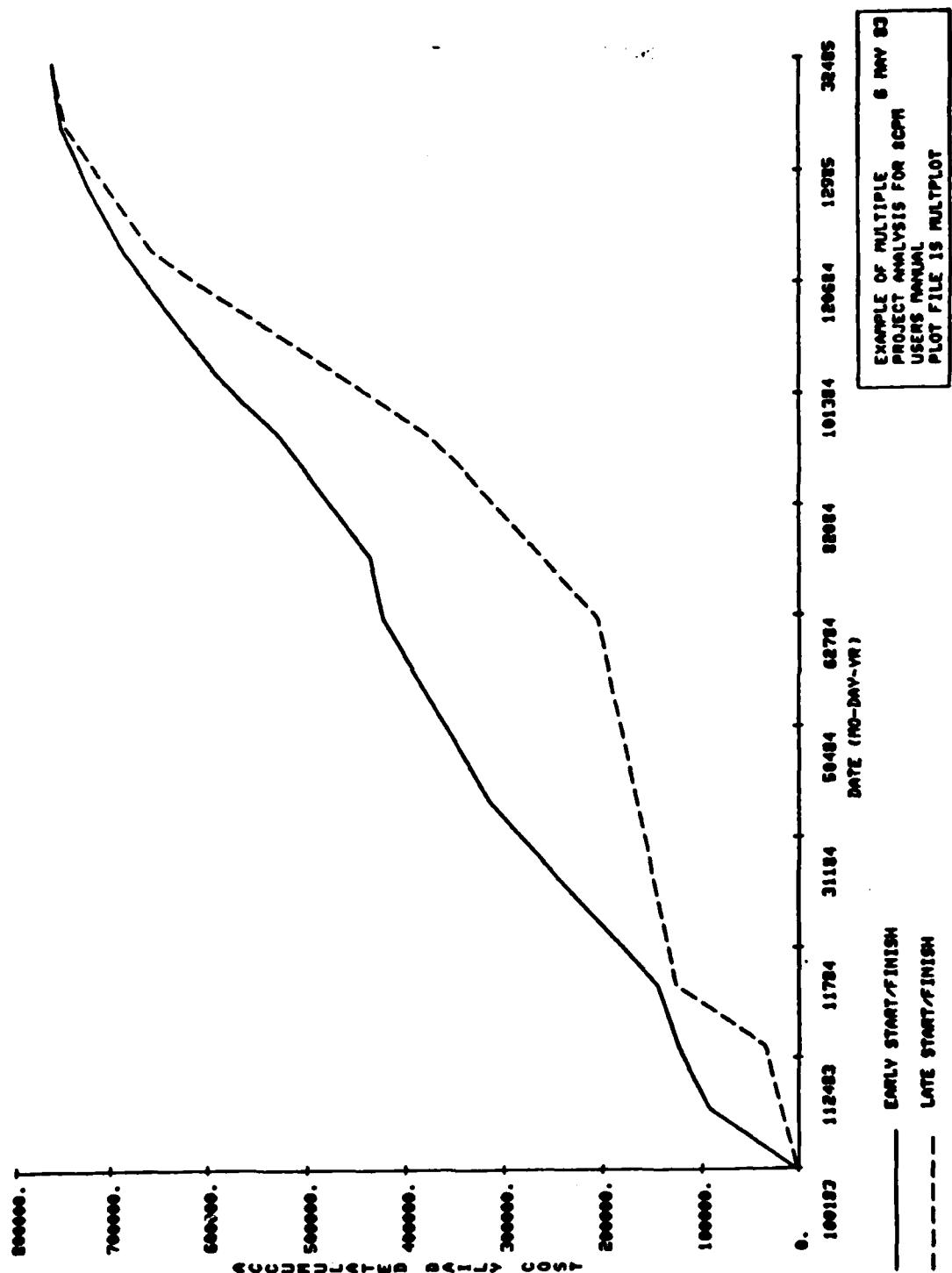


Figure 6.3-5: Accumulated daily cost curve for multiple project example.

APPENDIX A  
TERMINAL USER'S GUIDE

INTRODUCTION

This appendix shows how to use \*CPM and all its options. Each option on the \*CPM macro menu and its variations are shown on the following pages. Items which appear in quotation marks (i.e., "1,2") are examples of input. Please note the punctuation or lack thereof within the quotation marks to avoid input interpretation errors.

Option 00 - CRT Display

\*CPM  
WELCOME TO THE NETWORK ANALYSIS SYSTEM (CPM)

ENTER THE PROCESSING OPTION NUMBER TO BE EXECUTED  
(ENTER 00 TO GET A LIST OF PROCESSING OPTIONS):  
**00**

PROCESSING OPTION	NUMBER
LIST CPM PROCESSING OPTIONS.....	00
CPM DATA ENTRY PROGRAM.....	01
CPM PROGRAM COMPUTES CPM NETWORK--I-J ORDER.....	02
CPM SORTS CPM FILE CREATING PRINT PROGRAM INPUT FILE ..	03
CPM PROGRAM TO WRITE CALENDAR FILE FOR PRINT PROGRAM..	04
CPM PRINT PROGRAM AND PLOT FILE BUILDER.....	05
CPM ACTIVITY/CUST TEKTRONIX PLOT PROGRAM.....	06
CPM UPDATE OF TASK LIST FILE FROM OPTION 03.....	07
(USE FOR INPUT OF ACTUAL START DATE, * COMPLETE, MILESTONE DATE)	
CPM SEARCH FOR ORGANIZATION/PROJECT CODES.....	08
CPM ORGANIZATION/PROJECT CODES INDEX.....	09
CPM RA/PM INTERFACE PROGRAM.....	10
CPM HISTORY.....	97
CPM INSTRUCTIONS.....	98
TERMINATE CPM.....	99

This screen appears after you sign on and enter \*CPM.  
Select the task you want to perform and enter its number.  
(Remember that two digits are required.) The CPM system  
will execute the function you have chosen and return to  
the task number prompt shown at the top of the screen when  
the task you have selected is finished. Enter 00 if you  
do not remember the task number, and \*CPM macro menu will  
be displayed as shown above.

Option 01 - Initial Run CRT Display

ENTER THE PROCESSING OPTION NUMBER TO BE EXECUTED  
(ENTER 00 TO GET A LIST OF PROCESSING OPTIONS):  
01

1. CONTINUATION OR INITIAL RUN?  
I
2. FILE NAME:  
JOB IDENT LINE LIMITS ARE FLAGGED BY A COLON (:)
3. IDENTIFICATION LINE 1?
- IDENTIFICATION LINE 2?
- IDENTIFICATION LINE 3?
4. I,J (0,0 FOR END):
5. COST?
6. DURATION?
7. DESCRIPTION?
- I,J (0,0 FOR END):  
0,0
8. ARE YOU GOING TO CONTINUE LATER?

STOP

1. Enter "C" or "I"; if "I" is entered, the above prompts will be displayed.
2. Enter your CPM input file name: "PROJ1".
3. These three identification lines will appear in the heading of all output. Suggest Line 1 = Project Name; Line 2 = Project Location; Line 3 = User Name.
4. Enter I J number for activity: "1,2".
5. Enter cost of activity (\$): "25000".
6. Enter activity's duration (calendar days): "30".
7. Enter activity's description: "AIA-FE1 Draft Preliminary Plans".
8. Enter "Y" or "N": If you enter "Y", the program will not run your file through the remaining options. You must enter "N" to compute this file.

Option 01 - Continuation CRT Display

ENTER THE PROCESSING OPTION NUMBER TO BE EXECUTED  
(ENTER 00 TO GET A LIST OF PROCESSING OPTIONS):  
01

1. CONTINUATION OR INITIAL RUN?  
C
2. FILE NAME:
3. LAST RECORD ENTERED:  
I =            J =            DURATION =            COST =
4. I,J (0.0 FOR END):
5. ARE YOU GOING TO CONTINUE LATER?

STOP

1. Enter "C" or "I"; if "C" is entered, the above prompts will be displayed.
2. Enter file name from previous option 1 input: "PROJ1".
3. The computer will display the information for the last activity in the file.
4. Enter I, J number for next activity: "10, 12".
5. Enter "Y" or "N"; you must enter "N" if you want to compute from the contents of this file.

Option 02 - CRT Display

ENTER THE PROCESSING OPTION NUMBER TO BE EXECUTED  
(ENTER 00 TO GET A LIST OF PROCESSING OPTIONS):  
02

1. ENTER DATA FILE NAME FROM OPTION 01 OR 07:

AFTER STMT 590  
STOP

1. Enter the file name from either option 01 or the name of the updated file created in option 07. The program will now conduct the CPM calculations.

Option 03 - CRT Display

ENTER THE PROCESSING OPTION NUMBER TO BE EXECUTED  
(ENTER 00 TO GET A LIST OF PROCESSING OPTIONS):  
03

1. WHAT DO YOU WANT TO CALL THE PRINT PROGRAM INPUT FILE?
2. FILE            GENERATED

1. Enter the file name for print program input: "PROJ2".
2. The program will sort the option 2 output, read it into the new file, and display this statement when the file has been generated.

Option 04 - CRT Display

ENTER THE PROCESSING OPTION NUMBER TO BE EXECUTED  
(ENTER 00 TO GET A LIST OF PROCESSING OPTIONS):  
04

1. NTP ACK DATE (MMDDYY) ?
2. END DATE (CONTRACT DAYS + 15%) MMDDYY?
3. ENTER IDENT LINE:

ENTER IDENT LINE:

ENTER IDENT LINE:

JER =  
STOP

1. Enter the day before the initial day of the period under analysis. For example, if you want the analysis to begin on 1 October 83, enter 30 September 83: "093083".
2. Enter the last day of the period under analysis: "093085".
3. Enter three identification lines to identify this calendar file.

Option 05 - CRT Display

ENTER THE PROCESSING OPTION NUMBER TO BE EXECUTED  
(ENTER 00 TO GET A LIST OF PROCESSING OPTIONS):  
05

1. ENTER FILE NAME FOR INPUT (OPTION 03 OR 08 OUTPUT).
2. WHAT DO YOU WANT TO CALL YOUR CPM PRINTED OUTPUT FILE?
3. SUPPRESS DUMMY (0=NO,1=YES)?
4. I-J SORT, LATE START SORT,  
EARLY START SORT, EARLY FINISH SORT, LATE FINISH SORT  
TOTAL SLACK SORT, OR END?  
I-J SORT
5. WANT TO PLOT THESE COSTS/ACTIVITIES ON THE TEKTRONIX? (Y OR N)  
Y
6. WHAT DO YOU WANT TO CALL YOUR PLOT FILE?  
I-J SORT, LATE START SORT,  
EARLY START SORT, EARLY FINISH SORT, LATE FINISH SORT  
TOTAL SLACK SORT, OR END?  
END  
STOP
7. WANT CPM PRINT FILE COPIED TO PRINTER? (Y OR N)
  1. Enter the name of the file created in option 03 or option 08: "PROJ1".
  2. Enter the file name for the output created by this option: "PROJ3".
  3. Enter "0" or "1". If "1" is entered, all dummy activities in network will not be printed into output if the first three characters of the activity description are "DUM".
  4. Enter the name of the sort you want exactly as shown on display:  
"I-J SORT". If you want several sorts or all sorts, you must enter the names in the same order as shown in prompt - one sort per prompt.
  5. Enter "Y" or "N".
  6. Enter name for plot file: "PROJPLOT".
  7. Enter "Y" or "N"; if "Y", output will be copied on main printer.

Option 06 - CRT Display

ENTER THE PROCESSING OPTION NUMBER TO BE EXECUTED  
(ENTER 00 TO GET A LIST OF PROCESSING OPTIONS):  
06

1. WHAT IS THE NAME OF YOUR PLOT FILE  
GENERATED BY OPTION 05?
2. CHOOSE (1) ACTIVITIES PLOT ONLY, (2) COST PLOTS ONLY  
OR (3) BOTH PLOTS.  
3
3. DO YOU WANT TO SPECIFY STARTING AND ENDING DATES?  
(Y OR N)  
Y
4. ENTER YOUR STARTING DATE IN 312 FORMAT (MMDDYY):
5. ENTER YOUR ENDING DATE IN 312 FORMAT (MMDDYY):
6. DO YOU WANT COST GRAPH TO HAVE GRIDS? (Y OR N)  
N
7. DO YOU WANT TO CREATE A FILE CONTAINING DAILY COSTS?  
(Y OR N)  
Y
8. WHAT DO YOU WANT TO CALL THE DAILY COST FILE?
9.
1. Enter plot file name created in option 05: "PROJPLOT".  
2. Enter "1", "2", or "3": "1" will create a Gantt Chart from CPM  
network; "2" will create a resource histogram; "3" will create  
both.  
3. Enter "Y" or "N"; "Y" allows you to only graph a selected portion  
of data; "N" will graph all data.  
4. Enter starting date for selected period: "100183".  
5. Enter ending date for selected period: "093084".  
6. Enter "Y" or "N".  
7. Enter "Y" or "N" if you want the daily cost computations written  
into a file.  
8. Enter file name for cost file: "PROJCOST".  
9. The graphics selected in item 2 will now be displayed on the  
Tektronix plotter.

Option 07 - Additional CRT Display

ENTER THE PROCESSING OPTION NUMBER TO BE EXECUTED  
(ENTER 00 TO GET A LIST OF PROCESSING OPTIONS):  
07

1. YOU HAVE SELECTED THE CPM FILE UPDATE PROGRAM  
ENTER THE NAME OF THE DATA FILE GENERATED BY OPTION 03.

2. WHAT DO YOU WANT TO CALL THE UPDATED FILE?

STOP  
3. FILE NAME:  
ACTION(?) ,ADD(A) ,CHANGE(C) ,DELETE(D) ,STOP(S) \*  
A  
4. IMODE (?) \*\*\*\*\*  
JMUDER (?) \*\*\*\*\*  
1. DESCRIPTION \*\*\*\*\*  
2. COST \*\*\*\*\*  
3. DURATION \*\*\*

1. Enter file name created in option 3: "PROJ2".
2. Enter name for updated file: "PROJUP".
3. Enter "A", "C", "D" or "S": if "A" is entered, the prompts shown above will be displayed.
4. Enter information on activity to be added to network:

"4"  
"5"  
"AAA-FE1 DRAINAGE"  
"25000"  
"30"

Option 07 - Change CPT Display

FILE NAME:  
1. ACTION(?) ,ADD(A) ,CHANGE(C) ,DELETE(D) ,STOP(S) \*  
C  
2. IMODE (?) \*\*\*\*\*  
3. JMODE (?) \*\*\*\*\*  
4. 1. DESCRIPTION \*\*\*\*\*  
2. COST \*\*\*\*\*  
3. DURATION \*\*\*  
4. START DATE \*\*\*\*\*  
(MMDDYY)  
5. % COMPLETE \*\*\*\*  
6. MILESTONE \*\*\*\*\*  
(MMDDYY)  
5. ENTER 1,2,3,4,5,6 OR (S)STOP =  
5

1. Enter "A", "C", "D" or "S": if "C" is entered, the prompts shown above will be displayed.
2. Enter I number of activity to be changed (updated): "2".
3. Enter J number of activity to be changed (updated): "5".
4. Program will display current information on requested activity.
5. Enter "1", "2", "3", "4", "5", "6" or "S": program will display selected item. Enter updated information.

Option 07 - Delete CRT Display

FILE NAME:  
1. ACTION(?) ,ADD(A) ,CHANGE(C) ,DELETE(D) ,STOP(S) \*  
0  
2. IMODE (?) \*\*\*\*\*  
3. JMODE (?) \*\*\*\*\*  
4. 1. DESCRIPTION \*\*\*\*\*  
2. COST \*\*\*\*\*  
3. DURATION \*\*\*  
4. START DATE \*\*\*\*\*  
(MMDDYY)  
5. % COMPLETE \*\*\*  
6. MILESTONE \*\*\*\*\*  
(MMDDYY)  
5. IS THIS THE RECORD TO DELETE(Y OR N)? \*  
Y  
FILE NAME:  
6. ACTION(?) ,ADD(A) ,CHANGE(C) ,DELETE(D) ,STOP(S) \*  
S

CPM FILE UPDATE COMPLETE.

RETURN TO OPTION 02 AND 03 TO CREATE A NEW PRINT PROGRAM  
INPUT FILE.  
(MAKE SURE YOUR CALENDAR FILE IS STILL VALID FOR NEW DATES)

1. Enter "A", "C", "D" or "S": if "D" is entered, the prompts shown above will be displayed.
2. Enter I number of activity to be deleted: "2".
3. Enter J number of activity to be deleted: "5".
4. Program will display current information on requested information.
5. Enter "Y" or "N".
6. When update is complete, enter "S".

Option 08 - CRT Display

ENTER THE PROCESSING OPTION NUMBER TO BE EXECUTED  
(ENTER 00 TO GET A LIST OF PROCESSING OPTIONS):  
08

1. WHAT IS THE NAME OF THE FILE YOU WANT TO SEARCH?
2. WHAT DO YOU WANT TO CALL YOUR NEW PRINT PROGRAM INPUT FILE?
3. DO YOU WANT TO SEARCH FOR AN ORGANIZATION CODE, A PROJECT NAME CODE, OR BOTH? (ENTER OC, PNC, OR BOTH)  
BOTH
4. ENTER THE ORGANIZATION CODE YOU WISH TO SEARCH FOR:
5. ENTER THE PROJECT NAME CODE YOU WISH TO SEARCH FOR:
6. SEARCH COMPLETE...WANT TO PERFORM ANOTHER SEARCH?  
(Y OR N)  
N  
STOP

OPTION OC COMPLETE.  
ENTER OPTION OS TO PRINT FILE AND CREATE NEW PLOT FILE.

1. Enter the file name for the file created in option 3: "PROJ2".
2. Enter the new file name: "PROJ5".
3. Enter "OC, "PNC", or "BOTH": if "BOTH" is entered, the prompts shown above will be displayed.
4. Enter the three-digit organization code: "FE1".
5. Enter the three-digit project code: "AAA".
6. Enter "Y" or "N".

NOTE: This option can be used only if the first seven digits of every activity description are the project code, a dash, and the organization code: "AAA-FE1".

Option 09 - Organization Code Search CRT Display

ENTER THE PROCESSING OPTION NUMBER TO BE EXECUTED  
(ENTER 00 TO GET A LIST OF PROCESSING OPTIONS):  
09

1. ENTER: 1 TO SEARCH FOR ORGANIZATION CODE  
2 TO SEARCH FOR PROJECT CODE  
3 TO SEARCH FOR PROJECT AND ORGANIZATION  
4 TO ADD A PROJECT/ORGANIZATION  
99 TO STOP

1

2. ENTER THE NAME OF YOUR PROJECT/ORG CODE FILE:
3. WANT TO SEND SEARCH RESULT TO A FILE? (Y OR N)  
Y
4. WHAT DO YOU WANT TO NAME THE FILE?
5. WHAT ORGANIZATION CODE DO YOU WISH TO SEARCH FOR?
6. WANT TO SEARCH FOR ANOTHER ORGANIZATION? (Y OR N)  
N

ENTER: 1 TO SEARCH FOR ORGANIZATION CODE  
2 TO SEARCH FOR PROJECT CODE  
3 TO SEARCH FOR PROJECT AND ORGANIZATION  
4 TO ADD A PROJECT/ORGANIZATION  
99 TO STOP

NOTE: Option 09 is not a functional option. Its purpose is to create and access a file containing all codes and their meanings.

1. Enter "1", "2", "3", "4" or "99": if "1" is entered, the prompts shown above will be displayed.
2. Enter the name of the file created in "4" of this option: "PROJCODE".
3. Enter "Y" or "N".
4. If "Y", enter file name: "CODE1".
5. Enter desired organization code: "FE1". The program will display all entries in file with "FE1".
6. Enter "Y" or "N".

Option 09 - Project Code Search CRT Display

1. ENTER: 1 TO SEARCH FOR ORGANIZATION CODE  
2 TO SEARCH FOR PROJECT CODE  
3 TO SEARCH FOR PROJECT AND ORGANIZATION  
4 TO ADD A PROJECT/ORGANIZATION  
99 TO STOP

2

2. ENTER THE NAME OF YOUR PROJECT/ORG CODE FILE:

3. WANT TO SEND SEARCH RESULT TO A FILE? (Y OR N)  
Y

4. WHAT DO YOU WANT TO NAME THE FILE?

5. WHAT PROJECT CODE DO YOU WISH TO SEARCH FOR?

1. through 4. Same as page A-14.

5. Enter project code: "AAA". Program will display all entries containing this project code.

Option 09 - Project and Organization Code Search CRT Display

ENTER: 1 TO SEARCH FOR ORGANIZATION CODE  
2 TO SEARCH FOR PROJECT CODE  
3 TO SEARCH FOR PROJECT AND ORGANIZATION  
4 TO ADD A PROJECT/ORGANIZATION  
99 TO STOP

3

ENTER THE NAME OF YOUR PROJECT/ORG CODE FILE:

WANT TO SEND SEARCH RESULT TO A FILE? (Y OR N)  
N

WHAT ORGANIZATION CODE DO YOU WISH TO SEARCH FOR?

WHAT PROJECT CODE DO YOU WISH TO SEARCH FOR?

WANT TO SEARCH FOR ANOTHER PROJECT/ORGANIZATION?  
(Y OR N)  
N

Self-explanatory - combines previous two pages.

Option 09 - Project/Organization Code File CRT Display

1. ENTER: 1 TO SEARCH FOR ORGANIZATION CODE  
2 TO SEARCH FOR PROJECT CODE  
3 TO SEARCH FOR PROJECT AND ORGANIZATION  
4 TO ADD A PROJECT/ORGANIZATION  
99 TO STOP  
4
2. ENTER THE NAME OF YOUR PROJECT/ORG CODE FILE:
3. WHAT DO YOU WANT TO CALL YOUR NEW PROJECT CODE FILE?
4. ENTER THE PROJECT CODE (3 CHARACTERS OR LESS):
5. ENTER THE ORGANIZATION CODE (3 CHARACTERS OR LESS):
6. ENTER DESCRIPTION OF WORK (70 CHARACTERS MAXIMUM):
7. WANT TO ADD ANOTHER PROJECT/ORGANIZATION? (Y OR N)  
N
  
1. Enter "4".
2. Enter name of previous code file if applicable: "CODE".
3. Enter new code file name: "PROJCODE".
4. Enter first project code: "AAA".
5. Enter first organization code: "FE1".
6. Enter description: "INTERIOR DRAINAGE".
7. Enter "Y" or "N".

Option 10 - CRT Display

ENTER THE PROCESSING OPTION NUMBER TO BE EXECUTED  
(ENTER 00 TO GET A LIST OF PROCESSING OPTIONS)  
10

1. WHAT IS THE NAME OF YOUR OPTION 05 INPUT FILE?
2. WHAT DO YOU WANT TO CALL YOUR FY1 RA/PM FILE?
3. ENTER THE PROJECT CODE (3 CHAR):
4. ENTER THE FIRST LINE OF THE PROJECT DESCRIPTION  
(20 CHAR):
5. ENTER THE SECOND LINE OF THE PROJECT DESCRIPTION  
(8 CHAR):
6. ENTER THE APPROPRIATION CODE (12 CHAR):
7. ENTER THE FA PROJECT CODE (3 CHAR):
8. ENTER THE ADP WORK CODE FOR INTERIOR DRAINS  
FISCAL YEAR = 84. CODE SHOULD HAVE 12 CHARACTERS.  
ENTER 0 IF CODE IS SAME AS FOR PREVIOUS ACTIVITY DURING SAME YEAR.

1. Enter the name of the file created in option 03: "PROJ2".
2. Enter file name: "PROJX1".
- 3-8. Make required entries.

Option 97 - CRT Display

ENTER THE PROCESSING OPTION NUMBER TO BE EXECUTED  
(ENTER 00 TO GET A LIST OF PROCESSING OPTIONS):  
97

CPM PROGRAM HISTORY

OPTION	SOURCE (SOURC*)	DATE WRITTEN	AUTHOR	DIST.	LANGUAGE
01	560102A	4 AUG 80	LAMBRECHT	MOBILE	FORTRAN
02	560102B	71	NOULLET	PTSBGH	FORTRAN
03	560102C	18 OCT 72	NOULLET	PTSBGH	COBOL
04	560102G	6 NOV 73	--	PTSBGH	FORTRAN
05	560102D	71	NOULLET	PTSBGH	FORTRAN
06	560102H	MAR 83	STACKOWIAK	ST PAUL	FORTRAN (GCS)
07	560102F	JUN 82	--	MOBILE	COBOL
08	560102I	MAR 83	STACKOWIAK	ST PAUL	FORTRAN
09	560102J	APR 83	STACKOWIAK	ST PAUL	FORTRAN
10	560102P	MAY 83	STACKOWIAK	ST PAUL	FORTRAN

CONTACTS: MOBILE DISTRICT - GEORGE VELLA FTS 537-3330  
ST PAUL DISTRICT- ROBERT STACKOWIAK FTS 725-7761

HIT RETURN TO CONTINUE...

Option 98 - CRT Display

ENTER THE PROCESSING OPTION NUMBER TO BE EXECUTED  
(ENTER 00 TO GET A LIST OF PROCESSING OPTIONS):  
98

CPM INSTRUCTIONS

THIS PROGRAM USES THE CRITICAL PATH METHOD (CPM) TO ANALYZE NETWORKS. THE USER SHOULD BECOME FAMILIAR WITH THIS METHOD BEFORE USING THIS PROGRAM.

USE OPTION 01 TO INTERACTIVELY INPUT 3 PROJECT IDENTIFICATION LINES AND ACTIVITY I AND J NODES, COSTS, DURATIONS, AND DESCRIPTIONS. THE FIRST 7 CHARACTERS OF EACH DESCRIPTION SHOULD CONTAIN A PROJECT NAME (3 CHARACTERS) FOLLOWED BY A - FOLLOWED BY AN ORGANIZATION CODE (3 CHARACTERS). FOR EXAMPLE:

CHA-FE1 CHASKA HYDRAULICS STUDY

(NOTE: IF THE ACTIVITY IS A DUMMY, THE PROJECT NAME SHOULD BE DUM.)

AFTER YOU HAVE COMPLETED INPUT USING OPTION 01, USE OPTION 02 TO COMPUTE THE I-J ORDER. THEN USE OPTION 03 TO CREATE AN INPUT FILE FOR THE PRINT PROGRAM (OPTION 05). PRIOR TO RUNNING OPTION 05, YOU MUST ALSO RUN OPTION 04 TO CREATE A CALENDAR FILE CONTAINING THE DATES DURING WHICH THE PROJECT(S) WILL TAKE PLACE. A PERMANENT FILE NAMED CALENDAR WILL BE CREATED ON YOUR QUALIFIER.

HIT RETURN TO CONTINUE....

CPM INSTRUCTIONS CONTINUED

YOU MAY ADD ACTUAL START DATES, PERCENT COMPLETE, MILESTONE DATES, AND ADD, CHANGE, OR DELETE NODES FROM YOUR OPTION 03 PRINT PROGRAM INPUT FILE BY USING OPTION 07. OPTION 08 ALLOWS YOU TO SELECT PROJECT NAME AND/OR ORGANIZATION CODES FROM THE OPTION 03 PRINT PROGRAM INPUT FILE AND CREATE A NEW INPUT FILE.

OPTION 05 GENERATES A TABLE OF CPM ACTIVITIES, ACCUMULATED COSTS, AND COMPUTED EARLY AND LATE START/FINISH DATES AND SLACKS. IT MAY BE USED TO CREATE AN INPUT PLOT FILE FOR OPTION 06.

OPTION 06 IS A TEKTRONIX PLOT PROGRAM WHICH MAY BE USED TO GRAPHICALLY DISPLAY ACTIVITIES ALONG A DATE LINE AND/OR DAILY COST VERSUS DATE. IT CAN ALSO BE USED TO GENERATE AN AVERAGE DAILY COST SUMMARY TABLE.

OPTION 09 IS USED TO CREATE/MODIFY AN INDEX OF PROJECT AND ORGANIZATION CODES.

OPTION 10 IS USED TO CONVERT CPM PRINT PROGRAM INPUT INTO RA/PM INPUT.

\*\*\*\*\*

THIS CONCLUDES THE INSTRUCTIONS. HIT RETURN TO CONTINUE.

Option 99 - CRT Display

ENTER THE PROCESSING OPTION NUMBER TO BE EXECUTED  
(ENTER 00 TO GET A LIST OF PROCESSING OPTIONS):  
99

YOU HAVE LEFT THE CPM MACRO AND ARE NOW BACK AT  
JOB CONTROL.

